Status report on ENDANGERED WILDLIFE IN CANADA

1987

WOOD BISON

Recommended Status:

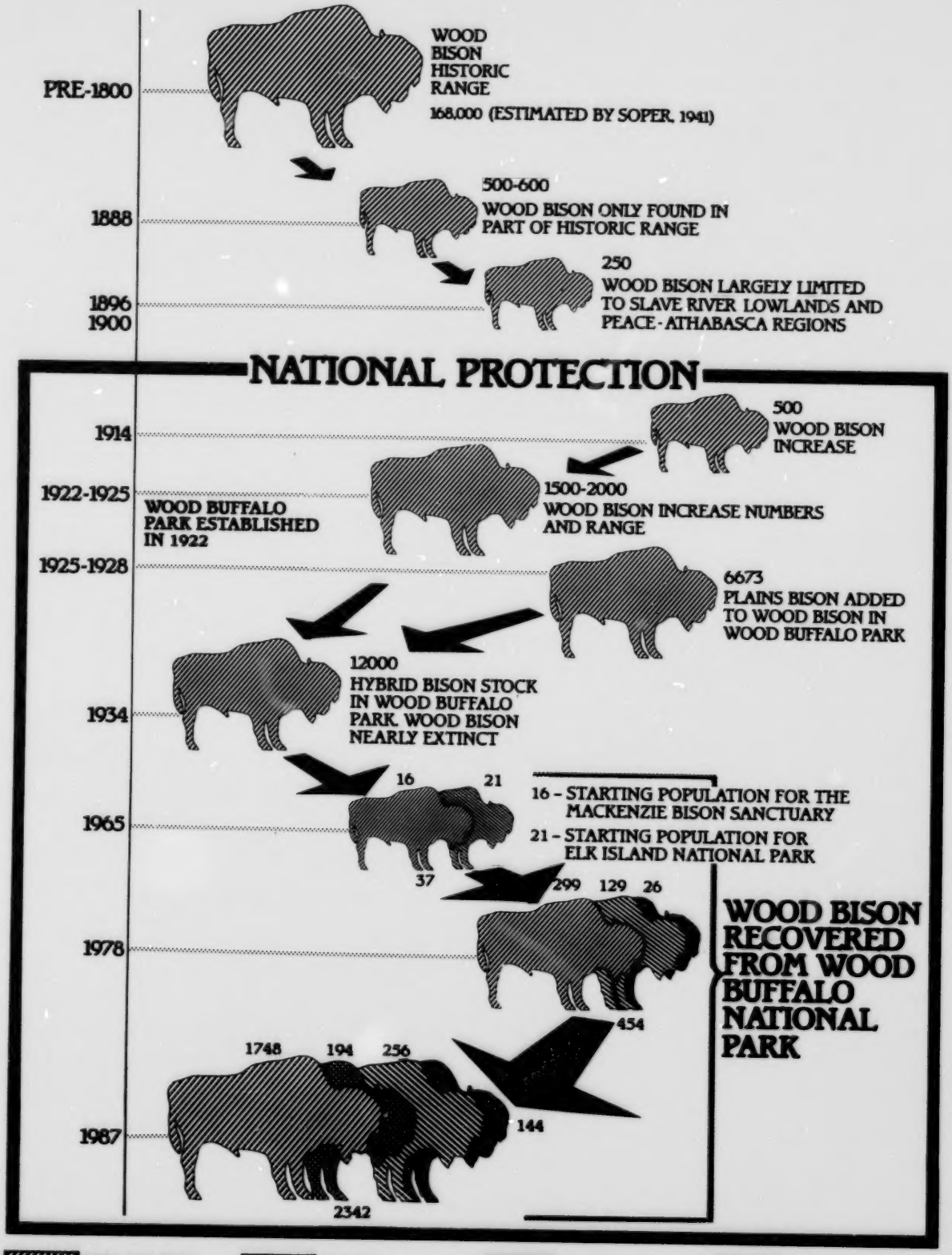
"*THREATENED*"

PREPARED BY: THE WOOD BISON RECOVERY TEAM

89-00846/

CHANGES IN WOOD BISON STATUS

1800-1987



STATUS REPORT ON WOOD BISON

(*Bison bison athabascae*) IN CANADA, 1987

Prepared by:

The Wood Bison Recovery Team

DECEMBER 1987

ABSTRACT

The wood bison (*Bison bison athabascae*) is recognized by the Committee on the Status of Endangered Wildlife in Canada as an endangered subspecies of the North American bison, distinct from its close relative, the plains bison (*B. bison bison*). Wood bison are an Appendix I species in the Convention on International Trade in Endangered Species thereby prohibiting international commercial trade. Current research on the systematics of the North American bison confirms the validity of subspecific status for wood bison. The Western Wildlife Directors support this scientific opinion and agree that wood bison and plains bison are to be treated as separate subspecies. This status report was prepared in response to a request from the Western Wildlife Directors.

Historically, wood bison range was centered to the northwest of plains bison range and included boreal forest regions of northern Alberta, southwestern Northwest Territories, northeastern British Columbia and northwestern Saskatchewan. Wood bison declined throughout their range from an estimated 168,000 in 1800 to a low of about 250 by 1900. Severe winters and hunting may have contributed to the decline. Early conservation efforts included protection through legislation in 1877 and 1893 and the establishment of Wood Buffalo Park in 1922. From 1925 to 1928, 6673 plains bison were introduced to Wood Buffalo Park from Wainwright, Alberta resulting in hybridization of the 1500 to 2000 resident wood bison. Bovine diseases, tuberculosis and brucellosis, were also introduced with the plains bison. By 1940, it was thought

that wood bison had become extinct through hybridization, but a small remnant herd was discovered in northwestern Wood Buffalo National Park in 1957. From this stock, confirmed to be wood bison, 18 animals were transplanted to the Mackenzie Bison Sanctuary in 1963 to establish a wild herd. Another 24, apparently disease-free animals, were shipped to Elk Island National Park in 1965 to establish a breeding herd for subsequent transplants. The numbers of wood bison in these herds now exceed 1718 and 250, respectively.

In 1975, a cooperative recovery program was formally initiated by federal, provincial, and territorial governments with the objective of reestablishing free-roaming herds of wood bison. Captive breeding herds have been established in seven zoos and wildlife parks. Since 1978, transplants to establish wild herds have been attempted in Jasper National Park and in the Nahanni district of the Northwest Territories. Fenced herds for future releases to the wild have been established in the Waterhen area of Manitoba, the Hay-Zama region of northwestern Alberta, and the Nisling River valley of the southern Yukon.

Total numbers of wood bison have increased steadily from less than 200 in 1959, to 450 in 1978, to more than 2300 in 1987. Approximately 85% of the total population is included in the Mackenzie Bison Sanctuary and the Elk Island National Park herds, about 9% are being held for eventual reintroduction in northern Alberta, central Manitoba, and the southern Yukon, and 6% are included in captive breeding populations in Canada, the United States, and Germany.

While rehabilitation efforts have been successful in a general sense, certain threats remain. Disease transmission and genetic

contamination of reestablished wood bison herds from plains or hybrid bison in the vicinity of Wood Buffalo National Park are obvious risks. The expansion of wood bison herds within historic range is limited or threatened by the existence of free-ranging plains or hybrid bison and by further agricultural development.

This report describes the status of existing herds of wood bison and identifies research requirements including aspects of physiology, behavior, mortality factors, and habitat relationships. Specific criteria required for the downlisting and delisting of wood bison have been presented. Based on the present status, the Wood Bison Recovery Team recommends that wood bison be downlisted from the "Endangered" to the "Threatened" category.

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LIST OF ACRONYMS

AFWD	Alberta Fish and Wildife Division
CITES	Convention on International Trade in Endangered Species
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DNA	Deoxyribonucleic Acid
EINP	Elk Island National Park
MBS	Mackenzie Bison Sanctuary
MWB	Manitoba Wildlife Branch
NR	Nyarling River
NWT	Northwest Territories
NWTWS	Northwest Territories Wildlife Service
WBNP	Wood Buffalo National Park
WWDC	Western Wildlife Directors Committee
YFWB	Yukon Fish and Wildlife Branch

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ACKNOWLEDGEMENTS

The Wood Bison Recovery Team acknowledges contributions from C. van Zyll de Jong, National Museum of Natural Sciences and K. Salmon, University of Alberta, pertaining to genetic relationships and taxonomy of bison. H. Nepinak, Waterhen Indian Band, is acknowledged for contributing Appendix 1, "The Wood Bison: An Indian Perspective". D. Slusar, Manitoba Department of Natural Resources, is thanked for designing and drafting the cover and frontispiece. S. Popowich, Canadian Wildlife Service is thanked for drafting the figures. G. Burns, Canadian Wildlife Service, provided valuable editorial and proof-reading assistance. M. Spence and J. Deroche, Canadian Wildlife Service are thanked for typing drafts of the manuscript. The Manitoba Wildlife Branch contributed financial support for printing the final report.

1. INTRODUCTION

In 1973, representatives of the Canadian Wildlife Service (CWS), Environment Canada-Parks (Parks), and territorial and provincial wildlife agencies from western Canada began meeting annually to develop a management strategy for wood bison (Bison bison athabascae). In 1975, a cooperative wood bison rehabilitation program was initiated by CWS in concert with the Northwest Territories Wildlife Service (NWTWS), Alberta Fish and Wildlife Division (AFWD), Manitoba Wildlife Branch (MWB), Yukon Fish and Wildlife Branch (YFWB), and Elk Island National Park (EINP) to establish a minimum of three free-ranging, self-perpetuating populations of wood bison in areas of historic range. The establishment of captive breeding herds in zoos and wildlife parks is a secondary objective of the program to preserve the gene pool.

At the Federal-Provincial Wildlife Conference in 1977, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was formed to assess and classify the status of wildlife whose survival in Canada might be in jeopardy. In 1978, a status report on wood bison was prepared for COSEWIC by Novakowski (1978). The wood bison was subsequently listed by COSEWIC as endangered in Canada (Novakowski 1979). It is currently recognized as an endangered subspecies of the North American bison (Cook and Muir 1984).

The wood bison has received international recognition as an endangered subspecies. In 1977, the Convention on International Trade in Endangered Species (CITES) listed the wood bison in Appendix I of CITES, thereby prohibiting international commercial trade and restricting trade to scientific or propagation purposes. Export and

import permits are required by CITES to transport Appendix I animals and their products across international boundaries. Canada is one of approximately 90 countries that belong to the Convention.

Periodic status reviews of all species listed by COSEWIC are required to ensure that classifications are current. The 1978 status report on wood bison outlined initiatives to preserve the subspecies. Since then, the total number of wood bison and the population distribution have changed significantly. In 1986, the Western Wildlife Directors Committee (WWDC) (Wildlife Directors from Manitoba, Saskatchewan, Alberta, British Columbia, Northwest Territories, the Yukon Territory, and CWS) requested preparation of an updated status report and a petition to COSEWIC to downlist the wood bison from the "endangered" to the "threatened" status. A Recovery Team, consisting of representatives appointed by the WWDC, was established to carry out this task and to prepare a national recovery plan for wood bison. This status report was prepared in response to the request of the WWDC.

2. HISTORY OF THE WOOD BISON

2.1 Early History and Numbers

Historically, the range of the wood bison was centered on the north central section of the Interior Plains Physiographic Region of Canada (Rowe 1972) including northern Alberta, southwestern Northwest Territories (NWT), northeastern British Columbia, and a small portion of northwestern Saskatchewan (Fig.1). Samuel Hearne, one of the earliest Hudson Bay Company explorers, was the first European to provide a record

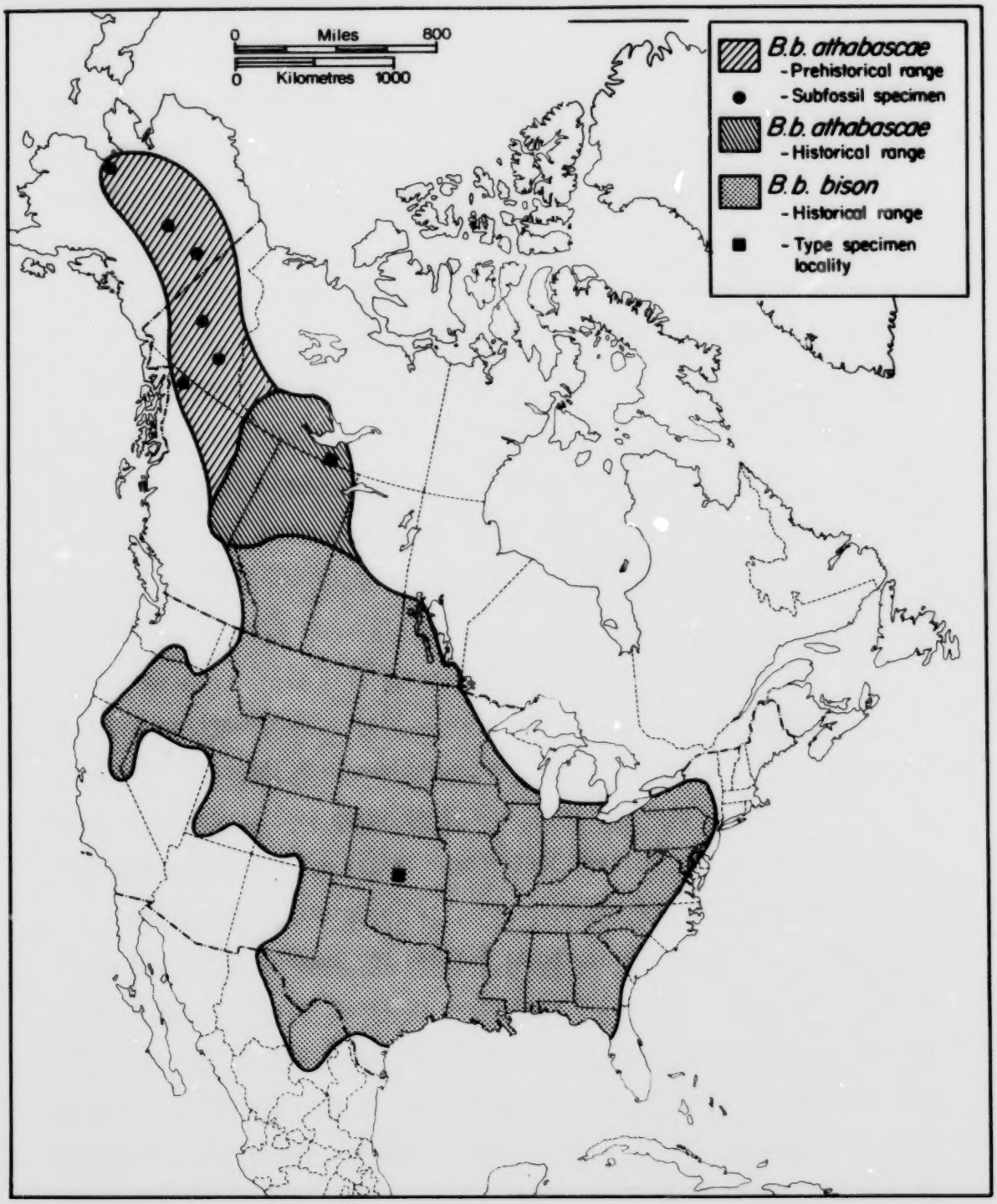

Figure 1. Historic and prehistoric distribution of wood bison (Bison bison athabascae) and historic range of plains bison (Bison bison bison), after van Zyll de Jong (1986).

of the wood bison subsequent to his journey through the Lower Slave River region of the NWT in 1772 (Hearne 1795). Historic records of wood bison at the extreme southern limit of their range are ambiguous because of probable hybridization within the overlapping range of the wood and plains bison.

Wood bison were never as numerous as plains bison and were distributed unevenly throughout a vast area of the boreal forest. Several descriptions of their abundance varying from "very plentiful", "reasonably numerous", to "no doubt as to the abundance" were recorded in the accounts of early explorers (Soper 1941). Soper (1941) estimated the total population of wood bison in 1800 at about 168,000 animals, based on a rough estimate of carrying capacity and the area of range occupied.

2.2 Near Extinction

The wood bison, like the plains bison, was nearly eliminated during the late 1800s. Its decline coincided with the rapid demise of the plains bison between 1840 and 1900 (Raup 1933). The most rapid depletion took place after 1860 (Soper 1941). By 1875, the wood bison had disappeared throughout much of its original range. The total population in 1888 was estimated at between 500 and 600 animals (Schultz 1888). In 1891, only 300 wood bison remained in the wilderness area between Great Slave Lake and the Peace-Athabasca Delta (Ogilvie 1893). The population reached an estimated low of approximately 250 during 1896-1900 (Soper 1941). After 1900, bison were occasionally observed throughout their historical range, but numbers were insignificant in areas other than the Slave River lowlands and the Peace-Athabasca

regions. In northeastern British Columbia, the last reported bison was shot in 1906 (MacGregor 1952). The specific cause of the decline of the wood bison throughout its range is unknown, but the introduction of firearms and several severe winters may have been contributing factors (Raup 1933).

2.3 Early Conservation

Early conservation efforts began in 1877 with the passing of the Buffalo Protection Act (Hewitt 1921); however, this measure was largely ineffective because of lack of enforcement. Legislation was reinforced in 1893 when the Dominion Government passed a law to protect the surviving wood bison (Soper 1941). Enforcement of this legislation was minimal until 1897 when the enforcement mandate was assigned to the Northwest Mounted Police. In 1907, the first police outpost was established at Fort Fitzgerald on the Slave River and the first formal patrol of the region occurred. In 1911, six Buffalo Rangers were appointed to patrol the northern range of the wood bison. The wood bison population increased slowly to approximately 500 by 1914 (Banfield and Novakowski 1960).

In 1922, Wood Buffalo Park was established by an Order-In-Council under the Forest Reserves and Parks Act in an attempt to save the wood bison from extinction (Soper 1941; Lothian 1979). The number of wood bison on the entire range at that time was estimated at between 1500 and 2000 (Seibert 1925; Soper 1941). Wood Buffalo Park became Wood Buffalo National Park (WBNP) in 1943 when it was included in the schedule to the National Parks Act (Mitchell 1976).

2.4 The Introduction of Plains Bison to Wood Buffalo Park

In 1905, the largest privately owned herd of pure plains bison in North America was threatened by the loss of grazing rights. Following negotiations between the Canadian government and the owner, 410 plains bison were purchased from the Pablo-Allard herd and shipped from Montana to EINP in 1907 (Lothian 1981). On completion of the newly enclosed Buffalo Park at Wainwright, Alberta in 1909, 325 plains bison from EINP, 218 plains bison from the original herd in Montana, and 77 plains bison from the exhibition herd in Banff were brought to Wainwright to form the core herd (Lothian 1981). Several more shipments of animals over the next five years brought the total number of plains bison introduced at Wainwright to 748. A census of the Buffalo Park herd conducted in 1913 indicated 1188 head of plains bison, but by 1923 the herd had increased to 6780. The range was being depleted and overcrowding was a problem.

Buffalo Park administrators announced a proposal for a phased slaughter to control the herd, but the plan received such public criticism that it was temporarily abandoned. A publicly more acceptable solution to the excess plains bison problem at Wainwright was to ship animals north to the recently created Wood Buffalo Park (Graham 1924). From 1925 to 1928, 6673 young plains bison were transported by rail from Wainwright to Waterways (now Fort McMurray), Alberta, the railway terminus, and then by barge down the Athabasca and Slave Rivers to Labutte Landing in Wood Buffalo Park near Hay Camp (Lothian 1981). The bison were then released at several sites along the west bank of the Slave River, south and north of Hay Camp, into range that was occupied by wood bison (Soper 1941). The transfer of plains bison into historic

wood bison range and into contact with the wood bison subspecies was seriously challenged by the American Society of Mammalogists (Howell 1925) and by individual biologists (Harper 1925; Saunders 1925). They believed that interbreeding would result in the loss of both subspecies of bison and that the wood bison population would become infected with disease.

Wood bison were considered to be disease-free at the time of the introduction of the plains bison; however, evidence of that status is not available. Bovine tuberculosis (Mycobacterium bovis) was identified in the Wainwright herd in 1919 and had probably been introduced through bison brought from Banff in 1909 (Hadwen 1941 in Lothian 1981). In 1923, 75% of the animals slaughtered at Wainwright had tuberculosis-like lesions. This discovery led to a decision to transfer only young bison to WBNP in the mistaken belief that tuberculosis was a disease of old animals only. The first occurrence of tuberculosis in bison in WBNP was reported in 1937-38 (Mitchell 1976). Choquette et al. (1961) reported tuberculosis-like lesions observed in WBNP bison in 1947-48. Brucellosis (Brucella abortus) was identified in WBNP bison in 1956 (Choquette et al. 1978).

The two subspecies of bison interbred as had been predicted. Subsequently, the number of hybrid bison in WBNP increased to an estimated 12,000 by 1934 (Soper 1941). Raup (1933) reported that the wood buffalo, as a race, was rapidly disappearing but speculated that an intact northern herd still survived. However, by 1940 it was believed that pure wood bison had become extinct as a result of hybridization.

2.5 Origin of the Wood Bison Recovery Program

During the 1950s, some zoologists expressed belief that small groups of wood bison still existed in remote areas of WBNP (Fuller 1962; Novakowski and Stevens 1965). In 1957, N. Novakowski, CWS, observed bison in the Nyarling River and Buffalo Lake area of northwestern WBNP during an aerial survey. He suspected that they were wood bison. In 1959, five specimens were collected from the herd of about 200 animals. Three adults were photographed and the skulls and skins were sent to the National Museum of Natural Sciences in Ottawa. Pelage characteristics, size, and cranial measurements compared favorably with specimens of authentic wood bison (Banfield and Novakowski 1960). The Nyarling River herd was, accordingly, classified as morphologically representative of wood bison.

In February 1963, 77 wood bison were captured in the Nyarling River area near Needle Lake with the intention of establishing a captive breeding herd of wood bison. At the capture site, 61 animals were tested for tuberculosis and brucellosis. One animal was positive for tuberculosis and 52% were infected with brucellosis. Twenty-one apparently disease-free wood bison were selected of which 19 were successfully transported by truck to a large holding corral west of Fort Smith (Novakowski 1963a). Three calves were born to this herd in the spring of 1963. During July, the bison were tested again for tuberculosis and brucellosis; results of these tests were negative. The herd was then declared disease-free by the Health of Animals Branch, Federal Department of Agriculture, and the three calves were innoculated for brucellosis (Novakowski 1963b).

After outbreaks of anthrax (Bacillus anthracis) occurred in bison in the Slave River lowlands in 1962 and at Grand Detour (an area located a short distance north of the holding site) in 1963, a decision was made to transfer a herd of wood bison to a suitable area north of Fort Providence, NWT. In August 1963, 18 of the orginally captured wood bison were barged to Fort Providence and then were transported by truck to a release site located approximately 25 km north of Fort Providence within the present-day Mackenzie Bison Sanctuary (MBS) (Novakowski 1963b). Bison were vaccinated for anthrax prior to shipment.

A second bison roundup in the Nyarling River area near Needle Lake in WBNP was held in February 1965. Of 69 bison that were discovered, 47 were captured in the roundup corrals and seven died from injuries and other causes. Forty of the 47 animals captured were subsequently transferred to the holding corrals at Fort Smith (Novakowski and Stevens 1965). Continued outbreaks of anthrax in the Slave River lowlands precipitated a decision to establish a herd of wood bison out of the region. After testing for brucellosis and tuberculosis, 24 animals were transported to EINP in the fall of 1965. One animal died on route and two more died in the Park later that year. A total of twenty-one wood bison survived to establish the breeding herd that has provided stock for relocations to the NWT, northern Alberta, Manitoba, Yukon, and to captive breeding herds in zoos.

In summary, a total of 59 wood bison (19 in 1963 and 40 in 1965) were captured in the Nyarling River-Needle Lake area and transported to holding corrals near Fort Smith. From the first group, 18 animals were transferred to the MBS near Fort Providence in 1963. Sixteen of these

wood bison survived to establish the MBS herd. From the second group, 24 animals were transferred to EINP of which 21 survived to establish this breeding herd. Present wood bison populations have been derived from a relatively limited gene pool, a total of 37 animals taken from northwestern WBNP. Therefore, it would seem advisable to broaden the genetic diversity of the wood bison subspecies if representative stock could be salvaged from bison populations in WBNP and the Slave River lowlands.

2.6 The 1975 Recovery Program

A renewed conservation effort for the preservation of wood bison began in the early 1970s with establishment of the Federal-Provincial Wood Bison Advisory Committee. In 1975, a cooperative recovery program for wood bison was formally implemented with the major objective of establishing three free-roaming, self-perpetuating populations of wood bison in areas of historic range. The ultimate goal was and still is the removal of wood bison from the list of endangered wildlife.

The first attempt, in 1978, to transplant and establish a free-roaming herd of wood bison, using animals from the EINP population, was not successful. During this attempt, 28 wood bison were transported from EINP to Willow Creek along the eastern boundary of Jasper National Park. Despite the presence of what appeared to be suitable habitat within the Park, most of the animals travelled in excess of 150 km north during the first 30 days following release from the temporary holding corral. They traversed rugged mountainous terrain through the Willmore Wilderness Park and eventually ended up in an area of agricultural development near Grande Prairie, Alberta. These wood bison had to be

rounded up and returned to EINP because of the potential conflict with agriculture and urban areas.

A transplant of wood bison to the Nahanni district of the NWT in 1980 was more successful than the Jasper transfer. However, the original group of 28 animals fragmented into several smaller groups and one herd of eight animals moved south into British Columbia (Reynolds 1982).

Three more transfers to establish free-ranging populations have been carried out since 1978. Herds, originating from stock at EINP and from surplus stock in zoos, are being established near Waterhen in the Interlake region of Manitoba, in the Hay-Zama Lakes region of northwestern Alberta, and near Carmacks in the Yukon Territory. The current status of these fenced herds is reviewed later in this report. As a secondary aspect of the Wood Bison Recovery Program, seven captive breeding herds have been established in zoos and wild animal parks in North America since 1976.

2.7 Present Status of Bison in Wood Buffalo National Park

The bison in WBNP are no longer classified as wood bison but are considered to be hybrid bison of which the degree of mixing is unknown. Until they can be analyzed in greater detail, the WBNP population can be designated as intergrades (van Zyll de Jong 1986). The introduction of more than 6000 plains bison to WBNP from 1925 to 1928 not only caused hybridization of the estimated 1500 resident wood bison but resulted in their infection with bovine diseases, tuberculosis and brucellosis. After the introduction of plains bison, the hybrid herd increased to an estimated 12,000 by the mid 1960s, but decreased to 9000 by 1972 and has

continued to decline to approximately 4200 animals by 1987.

Tuberculosis and brucellosis have spread throughout the WBNP herd. Today, about 50% of the herd have one or both diseases. The concern over possible transmission of these diseases to domestic animals has increased in recent years because mixed agriculture has moved closer to WBNP, game farming and livestock ranching have expanded, and grazing leases have become established in the area. Also, Canada has been declared brucellosis-free in the livestock industry and is soon to be declared tuberculosis-free. This disease-free status is threatened by the presence of diseased wild bison in and around WBNP. In addition, it is feared that the rapidly expanding MBS wood bison population may soon contact infected hybrid bison which would result in genetic contamination and disease infection of the majority of the world's population of wood bison.

In 1987, a Bison Disease Task Force was established to evaluate the problem of brucellosis and tuberculosis in bison in northern Canada. Seven different government agencies are represented on the Task Force. There are major concerns regarding the current situation and the possible spread of diseases to humans, domestic animals, and wildlife species other than bison. The Task Force has not yet completed its deliberations. Regardless of the future of bison in WBNP and adjacent areas, the wood bison is a recovering subspecies in Canada.

3. SPECIAL SIGNIFICANCE

3.1 Subspecies Recognition and Maintenance of Distinctiveness

The wood bison was first described as a subspecies by Rhoads

(1897). Since then it has been accepted as a valid subspecies by most mammalian taxonomists, but a minority has held divergent views (Hornaday 1889; Graham 1923; Garretson 1938; Flerov 1979). The origin, evolution, and taxonomy of bison have been subject to numerous studies (Skinner and Kaisen 1947; Fuller and Bayrock 1965; Bohlken 1967; Guthrie 1970, 1980; Geist and Karsten 1977; Wilson 1978, 1980; McDonald 1978, 1981; Harington 1980). The most recent research on the systematics of the North American bison supported the validity of subspecific status of the wood bison (van Zyll de Jong 1986). Based on the current information on bison taxonomy, the WWDC is in agreement with the scientific opinion that wood bison and plains bison are to be treated as separate subspecies. Therefore, the WWDC has requested that the Recovery Team proceed with the completion of a national recovery plan for wood bison and their management in Canada.

Geographic variation in historic populations of the North American bison appears to have been clinal in nature over most of its distribution in a predominantly south-north direction (van Zyll de Jong 1986). However, a phenotypic discontinuity existed in the northwestern part of the range, coinciding approximately with the grassland-boreal forest ecotone. This discontinuity between grassland and woodland populations, involving size and shape of the skull, postcranial skeletal features, body size and shape, and pelage characteristics, justifies the recognition of two subspecies, B. b. bison and B. b. athabascae (van Zyll de Jong 1986).

Analysis of cranial and postcranial features showed the remnant population of wood bison from the Nyarling River (NR) in northern WBNP

to be somewhat intermediate between B. b. bison and B. b. athabascae, but clearly demonstrated the close proximity of NR bison to the original athabascae. Outline shape and pelage characters likewise showed clear differences from B. b. bison and indicated that NR bison resemble B. b. athabascae in this respect as well. These findings warrant inclusion of NR bison in the subspecies B. b. athabascae in spite of the morphological evidence suggesting the apparent slight introgression of B. b. bison genes (van Zyll de Jong 1986). Unfortunately, phenotypic dissimilarity cannot be translated into precise genetic terms. It is, therefore, difficult to evaluate the degree of hybridization that occurred. On the basis of various sets of morphological characters used, at least 95% of NR individuals differed diagnostically from plains bison (C. van Zyll de Jong, pers. comm.).

Before the near annihilation of bison, subspecific distinctiveness between plains bison and wood bison was probably maintained by a combination of ecological and behavioral factors as well as by natural selection (van Zyll de Jong 1986). Ecological factors would have served to minimize interbreeding between the two subspecies because populations were largely spatially isolated by discontinuous habitats; historical data support this hypothesis (Roe 1970; Seton 1886, 1927). Interbreeding was minimized because different migration traditions tended to separate populations during the breeding season (Moodie and Ray 1976; Morgan 1980). Natural selection (Allendorf and Phelps 1981) imposed by the diverse habitats of the two subspecies may have played a role in maintaining allele frequencies and phenotypic distinctiveness between them.

3.2 Filling A Vacant Ecological Niche

Grass and sedge meadows are scattered throughout the boreal forest region in northwestern Canada. These meadows are well defined openings in a region otherwise dominated by trees such as, aspen (Populus tremuloides), balsam poplar (P. balsamifera), white spruce (Picea glauca) and black spruce (P. mariana). Large meadows or prairies were known to exist historically and persist today in the Peace River-Grande Prairie area, in the Hay-Zama Lakes region, in the Peace-Athabasca Delta, in the Slave River lowlands, along the shores of Great Slave Lake near Hay River, at Mills Lake on the Mackenzie River, and on the west side of Great Slave Lake. Many place names in northern Alberta reflect the occurrence of grasslands.

Wood bison in the MBS show a strong affinity for meadows, particularly wet sedge meadows, which are used almost exclusively during the winter (Larter and Gates 1987a). No other large native herbivore has evolved to compete for use of this niche in North America. With the disappearance of wood bison from most of its historic range during the last century, meadows and prairies in the boreal forest region have presented a vacant ecological niche. This niche will be reoccupied with the recovery of wood bison.

3.3 Legal Status of Wood Bison and their Habitat in Canada

3.3.1 Manitoba

In Manitoba the wood bison is recognized as endangered. The enclosure at Waterhen has been designated as a Wildlife Refuge under the Manitoba Wildlife Act; therefore, hunting is prohibited. When released, wood bison will be defined as wildlife in the Manitoba Wildlife Act and

will be classified as endangered. Absolute protection of wood bison from all hunting, including Treaty Indian rights, by formal legislation would require an amendment to the Natural Resources Transfer Agreement, an unlikely event. Plains bison in the province are not subject to the jurisdiction of the Manitoba Wildlife Act.

3.3.2 Saskatchewan

There are no wood bison in Saskatchewan outside of zoos, nor is the provincial government actively pursuing a wood bison transplant project. The status of wood bison could become an issue in Saskatchewan if wood bison from Alberta or Manitoba move into the province. The Saskatchewan Wildlife Act and its Regulations do not specifically refer to wood bison, but Section 2(3) of the Wildlife Regulations lists Bison, other than domestically raised bison, as "big game". This would include the wood bison and give the species full protection under the Saskatchewan Wildlife Act.

3.3.3 Alberta

In the province of Alberta, the wood bison is listed in the Wildlife act as an "endangered" species, whereas the plains bison is an "excluded" animal and is treated in the same way as domestic livestock. Hybrid bison are not defined in the Alberta Wildlife Act.

A Wood Bison Management Plan for Alberta has identified an extensive wood bison management zone in the northwestern part of the province (Reynolds et al. 1985). Presently, this zone has no special legislative status and no agricultural development within it. There are no known plans for future agricultural development in this zone. A land reservation application, including the area of the enclosure where wood

bison are being held, has been filed with the Alberta Lands Office by the AFWD.

The wood bison and their habitat at EINP receive the benefit of protection under the National Parks Act. Wood bison will be retained as one of the dominant ungulates in the south portion of EINP and they will be managed in a similar ecological role to that of plains bison in the main park (Blyth and Hudson 1987). The wood bison at EINP will serve as one of the primary disease-free herds required to ensure survival of the subspecies and it will continue to provide stock for transfers to the wild.

3.3.4 British Columbia

In British Columbia, bison were designated as wildlife by an Order-In-Council in 1975. In addition, they were designated as "big game" under the British Columbia Wildlife Act in 1982; however, the Act does not differentiate between wood and plains bison. Bison may be held in captivity under permit issued by the Wildlife Branch. Crown lands occupied by bison in British Columbia currently have no special status.

A proposed policy would zone the province for captive and free-ranging bison such that north of approximately 57^{o}N latitude, only wood bison will be permitted and south of this latitude only plains bison will be allowed. The Wildlife Branch is currently developing a wood bison reintroduction plan for the northern zone. Potential habitat for wood bison in the northern zone has not been assessed. Preliminary observations indicate that large areas of suitable habitat may occur along the Petitot and Liard rivers within historic wood bison range, and along the Dease and Blue rivers as well as near Atlin within prehistoric

range. In the southern zone, an escaped plains bison herd of approximately 350 free-roaming animals (1985 estimate) occupies habitat in the Pink Mountain-Sikanni Chief River areas. Agricultural land-use activities dominate in the Peace River area of the southern zone.

3.3.5 Northwest Territories

The Government of the NWT has a mandate to preserve and manage game by virtue of the Northwest Territories Act and regulations under the Northwest Territories Wildlife Act. The Wildlife Service is responsible for enforcing the Wildlife Act. Section 13 of the Northwest Territories Act states, "The Commisioner-In-Council may, subject to this Act and any other Act of the Parliament of Canada, make ordinances for the Government of the Territories in relation to ...: (q) the preservation of game in the Territories." Certain limitations on the mandate set out in Section 13 of the Northwest Territories Act are identified in subsections of Section 14:

...subsection (3) "Nothing in subsection (2) shall be construed as authorizing the Commissioner-In-Council to make ordinances restricting or prohibiting Indians and Eskimos from hunting for food, on unoccupied Crown lands, game other than game declared by the Governor-In-Council to be game in danger of becoming extinct."

Pursuant to subsection (3) of Section 14 of the Northwest Territories Act, an amendment was passed by the Governor General-In-Council:

P.C. 1964-760 SOR (Statutes of Revision)/64-198, 22 May 1964, to "declare wood buffalo to be game in danger of becoming extinct."

In general terms, Indians and Inuit may hunt for food any game that has not been declared endangered by the Governor-In-Council.

Presently, wood bison, muskox (Ovibos moschatus), polar bear (Ursus maritimus), and barren-ground caribou (Rangifer tarandus groenlandicus) are species that are declared endangered in the Northwest Territories Act and thereby receive the benefit of protection as deemed necessary through regulations under the Northwest Territories Wildlife Act. In addition, all consumptive uses of game such as, trapping or hunting for trade, all hunting of species declared as endangered in the Northwest Territories Act, and all non-Indian and non-Inuit hunting may be controlled through regulations in the Wildlife Act.

Wood bison in the NWT are generally assigned to one of two distinct populations: the Mackenzie Wood Bison Population, located on the west side of Great Slave Lake, and the Nahanni Wood Bison Population, consisting of animals released in 1980 which have settled along the South Nahanni and Liard Rivers. For the most part, land-use activities on the range occupied by both populations are regulated by the Territorial Lands Act and Territorial Land-Use Regulations. A small part of the range of the Nahanni population, in the vicinity of Yohin Lake, lies within Nahanni National Park which is protected by the National Parks Act.

Approximately half of the lands occupied by the Mackenzie wood bison herd fall within the MBS, but the sanctuary designation does not convey legal or protective status. The MBS is described under the Northwest Territories Wildlife Act, but, at the time it was established, the lands were not withdrawn from disposition pursuant to the Territorial Lands Act. Therefore, the MBS lands are not exempt from other land uses. In 1987, the Department of Renewable Resources

declared the central portion of the Mackenzie Bison Sanctuary as a Wildlife Conservation Area (Ferguson 1987).

3.3.6 Yukon

In the Yukon, legal circumstances regarding bison and their habitat are similar to those in the NWT. Section 17(3) of the Yukon Act (federal legislation) permits the passage of laws in respect to Indians and Inuit and their hunting of wildlife that has been declared by Governor-In-Council to be in danger of becoming extinct. In the Yukon, SOR/60-429 identifies bison, elk (Cervus elaphus), deer (Odocoileus sp.), and muskox as species in danger of becoming extinct. In addition, these species are declared "specially protected wildlife" in the Yukon Wildlife Act (Yukon legislation) and Section 12 of the Act prohibits any person from hunting these species except under specially issued provisions. To date (1987), provisions have not been enacted to allow hunting of bison.

The YFWB has filed a land reservation with the Lands Branch of Indian and Northern Affairs Canada on the wood bison enclosure, a 6 km^2 area in the Nisling River valley. The entire Nisling River valley is Federal Crown land. Presently, no agriculture is practised there nor are there any other land-use activities in the valley. Limited mining exploration occurs at the headwaters of some creeks in the Nisling watershed, but this activity is not expected to affect habitat for wood bison. The YFWB has proposed to designate the area as Wood Bison Range once a free-roaming herd of wood bison has been established. In the future, land-use activities that could adversely affect the bison will not be permitted in the designated area. In

addition, the YFWB is developing a policy that will prohibit importation of plains bison to the Yukon.

3.4 Other Aspects of Special Significance of Wood Bison

3.4.1 The Waterhen Project

The Wood Bison Re-Establishment Foundation Incorporated was established in Manitoba, largely through the efforts of the Canadian Wildlife Federation. The objective of this non-profit foundation is to provide annual operating funds to the Waterhen Wood Bison Project after termination of government funding scheduled for 1988. The Foundation is administered by a Board of Directors and has established a goal of raising one million dollars.

The success of the Waterhen project to date (1987) can be attributed primarily to the keen interest and sustained effort of the Waterhen Indian Band. The wood bison project will, with time, contribute to the economic development of this depressed area. The project has been especially popular with the media and has gained extensive local, national, and international coverage.

3.5 Regional Development

As agricultural development continues to expand into northern fringe areas, there is a corresponding loss of wildlife habitat and natural resource-related opportunities. The introduction of wood bison may be viewed as an alternative to conventional agriculture, offering economic, cultural, ecological, and aesthetic benefits. Harvesting wildlife for food is a traditional pursuit of native residents of northern regions, although large numbers of bison have not been available in most of these areas since before the turn of the century.

Thriving populations of wood bison would provide a source of meat and recreational hunting for other northern residents. In the Prairie Provinces, bison ranching is a profitable industry. In northern areas, development of this industry should be encouraged using wood bison rather than plains bison or cattle, especially on lands already alienated from wildlife.

4. DISTRIBUTION AND POPULATION TRENDS

4.1 Historic Range

In Canada, the historical distribution of wood bison included most of the boreal forest region of northeastern British Columbia, all of northern Alberta, a small portion of northwestern Saskatchewan, and the southwestern NWT (Fig. 1). The habitat of the wood bison was characterized by coniferous forests and aspen parkland with interspersed wet meadows and prairies. Prehistorically, wood bison ranged further north and west to include north-central British Columbia, most of the Yukon Territory, and central Alaska from the southeastern boundary to the Bering Sea (Skinner and Kaisen 1947; van Zyll de Jong 1986). A detailed description of their historical range has been presented by Reynolds et al. (1982a) as follows:

> "During the late 1700s wood bison were distributed throughout northern Alberta to points east of the Slave River and north to eastern Great Slave Lake, Yellowknife Bay, Lac la Martre, Fort Liard, and Fort Simpson in the Northwest Territories (Soper 1964). Areas in British Columbia where wood bison specimens have been recorded are at the mouth of the Kitimat River, Atlin, Cecil

> Lake, and Fort Saint John (Smith 1977). The western boundary of wood bison range is not well defined... The eastern boundary approximated a line from the southeastern end of Great Slave Lake along the east side of the Slave River, south to the west end of Lake Athabasca, and then irregularly south and southeast to the Clearwater River and Peter Pond Lake in northern Saskatchewan (Soper 1941). The southeastern boundary continued from Saskatchewan across central Alberta, at about the same line as the interface of the boreal forest region and the fescue grasslands, to the east slopes of the Rockies...".

Authors such as Roe (1970) and Ray (1974) believed that wood bison occurred sporadically in the transitional aspen forests near the southern limit of the boreal forest. However, van Zyll de Jong (1986) concluded, on the basis of analyses of historical specimens, that the southern boreal forest and adjacent parkland in Manitoba and most of Saskatchewan were inhabited by plains bison, whereas the boreal forest-grassland ecotone to the west in Alberta represented a zone of contact between the wood and plains bison.

There is one known reference to occurrence of wood bison in Manitoba based on a statement to J.A. Allen by the U.S. Consul in Winnipeg in 1873 (Roe 1970). This claim of wood bison in Manitoba was rejected by van Zyll de Jong (1986) because the source of information could not be tracked down and the historical specimen data did not support it. However, Manitoba is not well represented by historical specimens of bison and collection of more from the northern Interlake area would be useful for further taxonomic study. Paleontological data

indicate that plains bison evolved with the formation of the present grasslands following the last glaciation approximately 5000 to 7000 years ago, strongly suggesting that habitat exerted intense selective pressures (van Zyll de Jong 1986). Prehistorically (predating written records), the parklands were not as extensive as they are today, probably because grasslands were then perpetuated by the extensive grazing of wild ungulates and the use of fire by native Indians. This may explain, in part, why plains bison extended north into what is today parkland habitat. Regardless of which subspecies was present in the northern Interlake or on the east side of Lake Winnipeg, it was occupying range that is currently recognized as suitable habitat for wood bison (Payne 1987).

4.2 Current Population Status

4.2.1 Manitoba Project

A transfer of 34 wood bison to a 23 km^2 enclosure in the northern Interlake district near Waterhen was accomplished in February 1984. By October 1987, the total population increased to 106 as a result of subsequent shipments and births within the enclosure. All wood bison transferred to Manitoba came as surplus animals from captive herds in the breeding program. The male:female sex ratio (62:40) is skewed toward males. There were 16 animals (four females, 12 males) that were born on site during 1984-86. A release to the wild from a separate 15 km^2 enclosure is scheduled for spring 1988. Prospects for sustained herd growth appeared favorable in terms of the successful production of 11 calves in 1986. However, only four calves were observed by 30 August 1987 out of an anticipated calf production of 15 to 20.

4.2.2 Alberta Project

Twenty-nine wood bison were transferred in February 1984 from EINP to a 3 km^2 enclosure located along the Hay River east of Hay-Zama Lakes in northwestern Alberta. Mortality and poor calf production have slowed growth of the herd. Only 10 calves were born at Hay-Zama during three years (1984-86) and only five of these survived. In March 1987, there were 34 wood bison in the Hay-Zama enclosure, 19 females(including one calf born in 1986) and 15 males. Flooding and severe winter conditions have resulted in the need for supplementary feeding within the enclosure. Poor calf production as a result of nutritional deficiencies may now be resolved through the supplementary feeding program. By September 1987 at least nine calves had survived. Release to the wild has been postponed until the potential risk of infection with tuberculosis and brucellosis from hybrid bison emigrating from WBNP is evaluated.

4.2.3 Yukon Project

The Yukon wood bison herd is being maintained in a 6 km^2 enclosure located in the Nisling River valley approximately 190 km northwest of Whitehorse. In March 1986, 34 wood bison were transported 2400 km from EINP to the Nisling River enclosure. The transplant herd consisted of 15 males and 19 females of which 12 females were of breeding age. Between late April and early June 1986, 11 calves were born in the enclosure. The total population in March 1987 was 45 animals. All bison survived the winter; however, one yearling male died in the spring of 1987 as a result of injuries sustained from fighting and only one calf was born in 1987.

As a result of an aerial reconnaissance survey of 26 potential release sites in the Yukon, the Nisling River watershed was considered to be most suitable (Reynolds et al. 1982c). A range assessment in this area resulted in a carrying capacity estimate of about 400 bison (Reynolds et al. 1982b). The first release to the wild is scheduled to take place during the spring of 1988 in an attempt to establish a free-roaming herd in the Nisling River valley.

4.2.4 British Columbia

There were approximately 350 free-roaming plains bison in the Pink Mountain-Sikanni Chief River areas in 1985, offspring of bison that escaped confinement from a privately-owned ranch. A herd of eight wood bison were observed in the Seeds Creek-Prophet River and Fort Nelson River areas during the 1980s but have not been observed since 1983. One of these bison was illegally killed in 1981. These wood bison emigrated from a transplant to the Nahanni region, NWT in 1980. Another small group of bison has been reported in the Kotcho Lake area north of Fort Nelson. That group possibly arrived by natural emigration from the NWT or Alberta, and could be either wood bison or hybrid bison.

4.2.5 The Northwest Territories Herds

4.2.5.1 The Mackenzie Population

In August 1963, 18 wood bison (six males and 12 females) were transplanted from WBNP to the MBS on the west shore of Great Slave Lake, NWT. The population grew to more than 1200 bison after calving in 1984. During April 1987, 1718 bison were counted (C.Gates, pers. comm.). The population has shown a consistently high rate of growth since it was introduced (Fig. 2). The growth of the Mackenzie

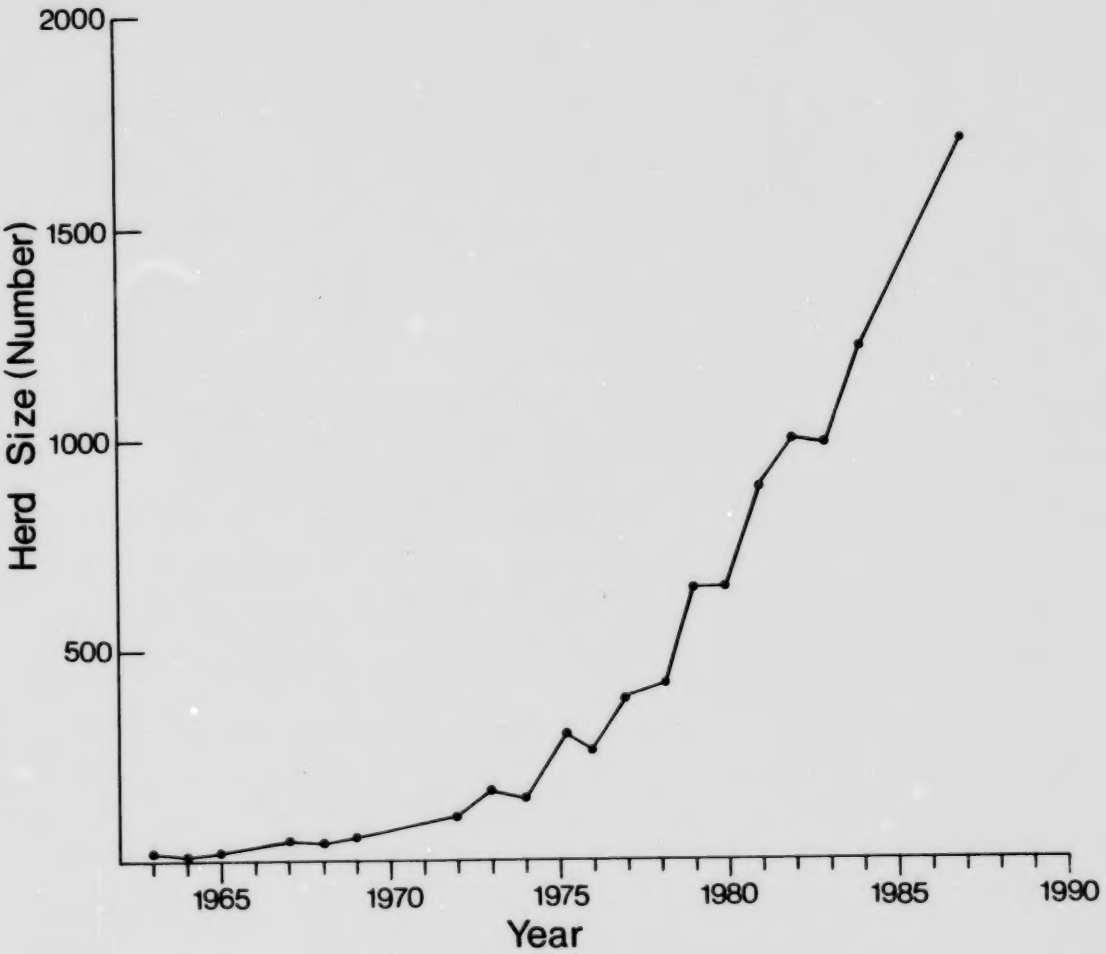

Figure 2. Population growth of wood bison in the Mackenzie Bison Sanctuary.

population from 18 animals in 1963 to at least 1718 in 1987 can be described by an exponential equation with a growth rate of 0.215, and r^2=0.985. A total count of the population is becoming increasingly difficult to carry out as bison numbers increase and their range continues to expand (Fig. 3). New census methods will be tested during late winter 1987-88. The rapid growth of the Mackenzie bison population can be attributed to good reproduction and high survival rates in all age classes. Several factors including protection from hunting, low incidence of disease, and low predation by wolves have contributed to this growth.

Following their release in 1963, the wood bison moved into the Falaise Lake area in the southeastern part of the MBS (Fig. 3). Although Falaise Lake continues to serve as a focal point for the population during winter, expansion into the adjacent major lake beds has occurred. During recent years, the herd has expanded its range in the northwest direction. Bison were first noticed in the Mink Lake area, 25 km west of the MBS, in 1980. Since then, the number of wood bison reported in this area has increased substantially (200 in 1984; over 400 in 1986). Movement of bison between the MBS and Mink Lake is evident along seismic and fire control lines cut through the forest. The Mink Lake area was burned by natural fires in 1974 and again in 1980 thereby creating open meadow habitat favorable for bison.

The carrying capacity of the entire range is not known, but continued population expansion into other suitable habitat is expected. In 1987, bison were seen near Fort Providence and at Mills Lake. A habitat evaluation program was conducted in the MBS to determine range

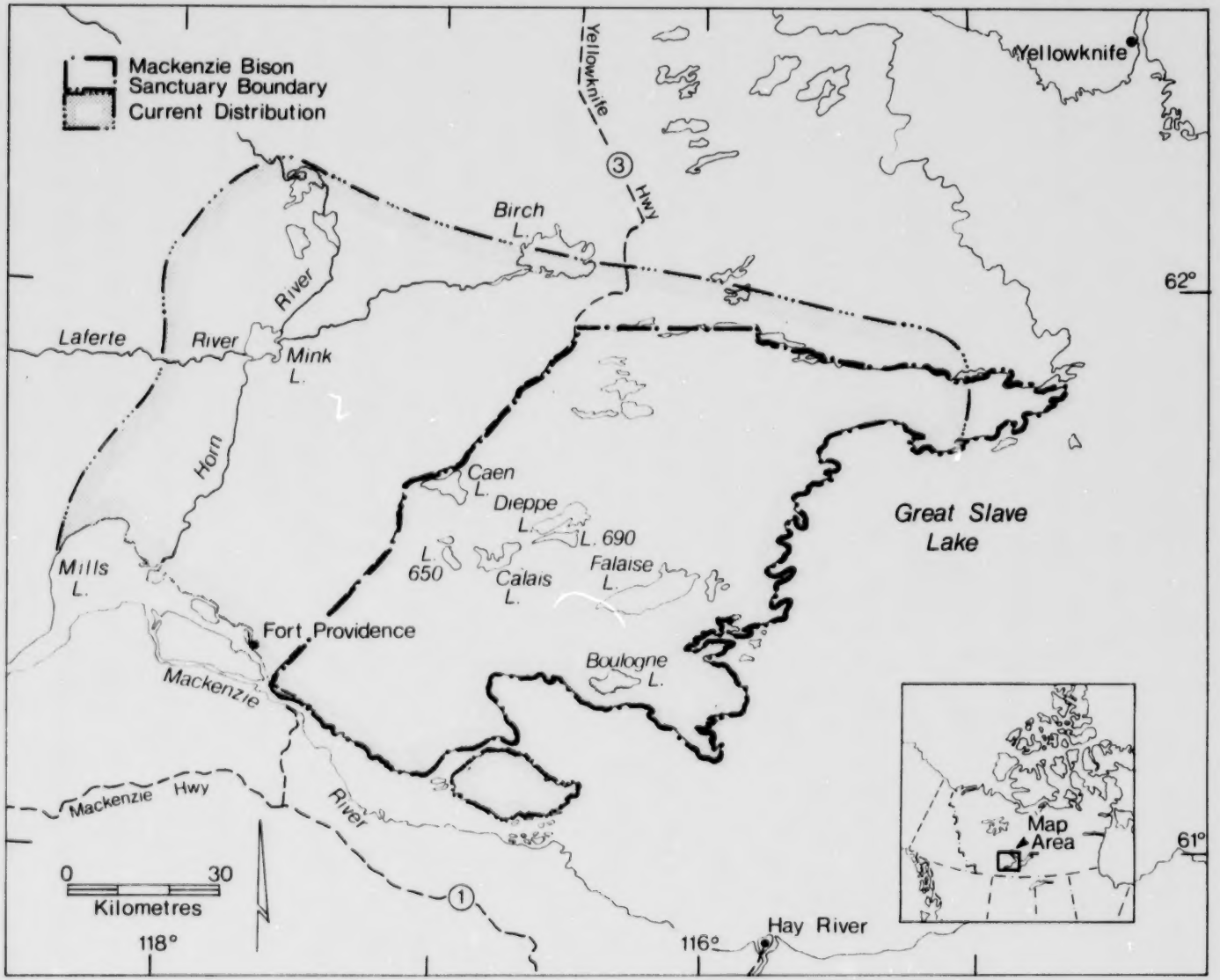

Figure 3. Current distribution of wood bison in the Mackenzie Bison Sanctuary and adjacent lands.

composition and biomass of available forage. The results of the habitat research indicated that a population of 7100 wood bison could be supported in the MBS based on available forage and assuming an even grazing pressure throughout the various meadow habitats (Government of the Northwest Territories 1987).

4.2.5.2 The Nahanni-Liard Population

In June 1980, 16 female and 12 male wood bison were transported from EINP and released on the north bank of the South Nahanni River near Nahanni Butte. Some of these wood bison dispersed considerable distances from the release site during the first year as small fragmented herds moved randomly throughout the region. During fall 1980, eight animals followed a winter road south to the Fort Nelson area in northeastern British Columbia, a linear distance of approximately 250 km. Seven bison were seen on the Dene Reserve near Fort Nelson and one young male was reported near the old town of Fort Nelson. These bison were identified as part of the Nahanni release because some of them were wearing radio collars. The current distribution and status of this component of the Nahanni release is not known although one of these was illegally killed. Six other animals were unaccounted for, resulting in a founding population of 14 wood bison in the NWT as observed in 1981.

Locations of wood bison were determined by using radio telemetry during the first 15 months following the release at Nahanni Butte. The dispersion pattern included the area along the Liard River northeast of Nahanni Butte to the mouth of the Blackstone River, upstream along the South Nahanni River to the braided area of the river bed locally known

as "The Splits", and the area along the Liard River and the highway south to Fort Liard. The present distribution of the Nahanni-Liard population is generally within this region.

Two distinct herds of wood bison appear to have emerged from the Nahanni release. One group of three to six animals is frequently observed between Yohin Lake and Nahanni Butte along the South Nahanni River (The Splits herd). The other group of approximately 21 animals (The Liard herd) ranges from the meadows near the mouth of the Netla River south to Fort Liard along both sides of the Liard River. Habitat use has not been studied, but the animals are frequently observed on the meadows associated with the Netla River, on islands in the Liard River during winter, and along the Liard highway during summer.

The Nahanni-Liard wood bison herd has continued to produce calves each year since the release. During June 1981, four calves were seen with eight adults near the Flett airstrip on the west side of the Liard River. The greatest number of calves was recorded in June 1986 and June 1987 when seven calves were produced by 12 cows in each year. During June 1987, the total population was 24 adults and 6 calves.

4.2.6 Elk Island National Park Population

In August 1965, 24 wood bison (six males, 17 females, one unknown) were transferred to the Isolation Area at EINP from WBNP. One animal died during transport and two died at the park before year end, leaving 21 animals as the founding herd of wood bison at Elk Island.

During 1966, no mortalities occurred and one calf was born. The following year, 13 calves were born and one more calf was flown to Elk Island from the holding corral near Fort Smith. In 1967, one calf died

during calving and one was killed during the fall roundup; however, a total of 12 calves survived that year. In 1968, 16 calves were produced, but one died at birth, one died of an umbilical hernia, and one dead calf was found. These losses were partially off-set by the arrival of two female calves from the Fort Smith corral in August of 1968.

During the summer of 1968, a three-year old bull tested positive for tuberculosis and was the first animal to be destroyed in an intensive slaughter program to eradicate disease. Later that year, seven more adults tested positive for tuberculosis and were subsequently destroyed. In 1969, there were 11 calves born bringing the total herd to 55 wood bison. Herd size was reduced to 31 in December 1969 through the slaughter of the original 21 wood bison for disease control and the death of three calves.

During the next few years herd growth was marginal; only two calves were born in 1970, nine in 1971, and 11 in 1972. Roundups and processing animals through the corrals resulted in the death of three to four individuals each year. However, by 1971, tuberculosis and brucellosis had been eradicated through a test and slaughter program. By 1976, the herd had increased to 111 wood bison and four calves were shipped to the Calgary Zoo, the first transfer from EINP to establish captive breeding herds. A healthy crop of 28 calves in 1977 made the second and third transfers possible: 10 animals to Metro Toronto Zoo and two animals to the Wildlife Reserve of Western Canada, Cochrane (Schwanke 1979). The growth of the wood bison herd from 31 animals in 1969 to 111 in 1977 can be described by an exponential equation with a growth rate of 0.188, and r^2=0.992 (Blyth and Hudson 1987).

Thirty-eight animals were removed from the Elk Island herd in 1978 for the Wood Bison Rehabilitation Program. In addition, ten adult males were collected for taxonomic research and to reduce the adult male component in the herd. The park herd numbered 102 wood bison in 1979. In 1980, 30 calves were produced representing a 22% increase, but a group of 28 wood bison was shipped and released near Nahanni Butte, NWT. An additional 16 animals were shipped to other locations. The February 1981 population numbered 110 animals. Twenty-nine calves were born in 1981, representing an increase of at least 26%. During the next two years, the population increased by 29% and 23%, respectively. By 1983, the population totalled 180 animals.

During 1984 and 1985, the rate of increase declined to 15% and 5%, respectively, marking the end of a 13-year period of remarkably stable population growth. Blyth and Hudson (1987) reported the average rate of growth from 1965 to 1983 was 26% (Fig. 4). However, the large proportion of females in the initial herd, the destruction of diseased animals in 1969, and removals to establish other herds significantly influenced the growth rate in this population. The total number of wood bison transferred from the park herd between 1965 and 1983 was 211.

4.3 Summary of Current Population Status

The discovery of free-roaming wood bison in WBNP in 1957 led to the development of a recovery program that has brought the population from an estimated low of 200 to in excess of 2300 in 1987 (Table 1), an eleven-fold increase. Eight captive breeding herds (six in Canada, one in the United States, and one in the Federal Republic of Germany), exhibit more than 140 wood bison and contribute to preservation of the

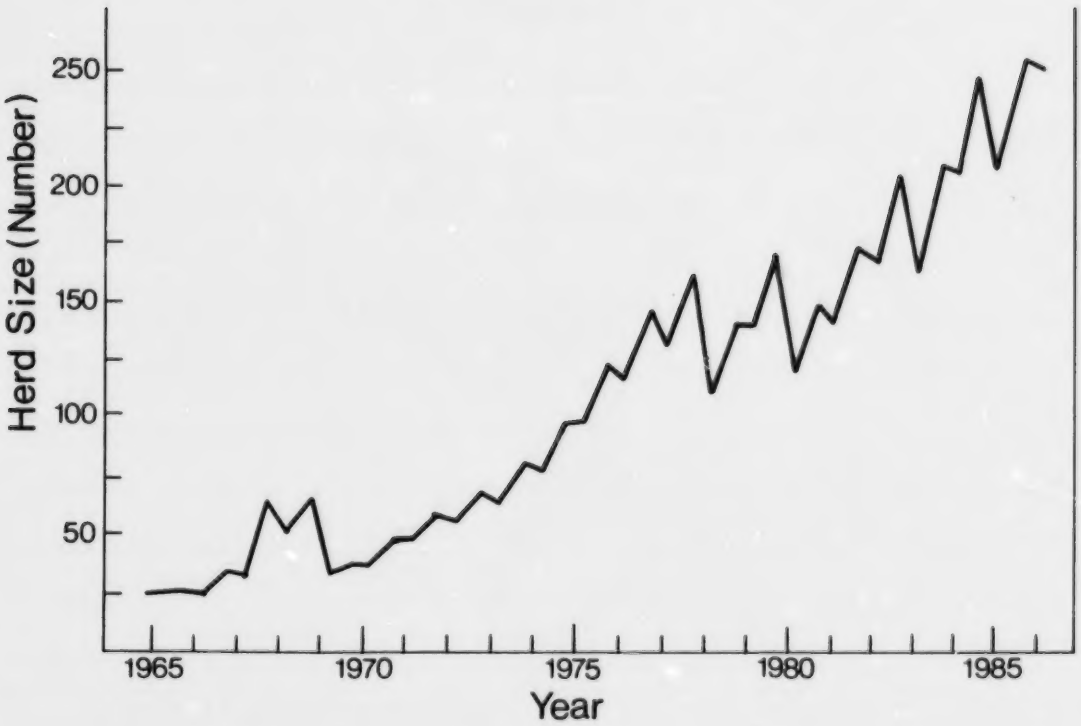

Figure 4. Population growth of wood bison in Elk Island National Park.

Table 1. The current status of wood bison populations derived from bison captured in northern Wood Buffalo National Park in 1963 and 1965.

HERD TYPE AND LOCATION	TRANSFER YEAR	SOURCE[a] of STOCK	NUMBER TRANSFERRED Males	Females	Total	FALL 1987 STATUS Adults Males	Adults Females	Calves Males	Calves Females	TOTAL
CAPTIVE BREEDING										
Calgary Zoo	1976	EINP	1	3	4	1	2	-	-	3
Metro Toronto Zoo	1977	EINP	7	3	10	6	14	2	5	27
Moose Jaw Wild Animal Park	1978	EINP	5	5	10	14	13	4	6	37
San Diego Zoo	1979	EINP	1	2	3	3	5	-	1	9
Valley Zoo	1980	EINP	1	1	2	1	1	-	-	2
Alberta Wildlife Park	1980	EINP	10	5	15	16	21	3	4	44
Banff National Park	1981	EINP	1	4	5	5	4	2	2	13
Munich Zoo, Germany	1981	EINP	2	3	5	3	6	?	?	9
Subtotal					54					144
FENCED - SEMI-WILD										
Elk Island National Park	1965	WBNP	4	17	21	114	108		34[b]	256
Subtotal					21					256
FREE-ROAMING - WILD										
Mackenzie Bison Sanctuary	1963	WBNP	6	12	18			?	?	1718[c]
Nahanni-Liard River Valley	1980	EINP	12	16	28	10	14		6[b]	30
Subtotal					46					1748
FENCED FOR REINTRODUCTION										
Waterhen, Manitoba	1984	EINP	16	18	34	62	40		4[b]	106
Hay-Zama, Alberta	1984	EINP	15	14	29	15	19		9[b]	43
Nisling River, Yukon	1986	EINP	15	19	34	19	25		1[b]	45
Subtotal					97					194
TOTAL										2342

[a] EINP = Elk Island National Park; WBNP = Wood Buffalo National Park
[b] sex of calves unknown
[c] minimum population estimate before calving in 1987

gene pool. A major portion of the total wood bison population (87%) is contained in three herds, the MBS herd (1718), the Nahanni-Liard herd (30), and the fenced, semi-wild herd at EINP (256). Fenced herds in Alberta, Manitoba, and the Yukon include approximately 200 more wood bison that are being held for eventual introduction to the wild. In total, there are at least 14 different herds of wood bison varying in number from one breeding pair to more than 1718 animals.

5. GENERAL BIOLOGY

5.1 Habitat Selection

5.1.1 Mackenzie Bison Sanctuary Population

The MBS is situated in the Upper Mackenzie Section of the Middle Subzone of the Boreal Forest Region (Rowe 1972, 1985). In addition to the typical cover types of the boreal forest, there are large wet and mesic meadows associated with shallow depressions. These depressions are relict lake beds with well-defined shorelines that typically contain only small areas of water after spring runoff. Sedge and grass communities that surround water bodies can yield up to 5800 kg/ha dry matter of herbage standing crop late in the growing season (Mychasiw 1987). Vegetation asscciations in the MBS are representative of wood bison habitat in the Boreal Forest Region.

Information on the resource use behavior of free-ranging wood bison in the MBS population has been reported (Larter and Gates 1987a). During spring and early summer, wood bison most often forage in mesic meadows, where dominant herbaceous species are reedgrasses (Calamagrostis spp.), wheatgrass (Agropyron trachycaulum), foxtail

barley (Hordeum jubatum), and slough sedge (Carex atherodes). Several species of willow (Salix spp.) and, to a lesser extent poplars (Populus spp.), are the dominant shrubs in the habitat. In wet meadows, dominant plant species are slough sedge and water sedge (Carex aquatilis). Use of wet meadows during summer coincides with hot weather and may be related to seeking cool environs as much as to foraging behavior. Later in summer, wood bison disperse into small groups and occupy coniferous and mixed-wood forests. This change in habitat selection coincides with the rut which lasts from mid July to October in the MBS. During the rut wood bison are rarely seen in open areas.

After the ground has frozen, usually in November, wood bison in the MBS shift to open habitats, particularly wet meadows. Large aggregations are typically present in these habitats throughout the winter although weather may influence daily use patterns. Wood bison continue to use wet meadows until spring runoff water accumulates and the soil thaws.

5.1.2 Elk Island National Park Population

The wood bison herd at EINP is confined to the south side of the park, a fenced area of about 59 km^2 (Blyth and Hudson 1987) in which the animals are permitted to free-range except during the annual roundup in December or January. Animals are baited with hay into a corral where they are individually processed and held for a period of about three weeks during the roundup. The Wood Bison Area, once known as the Isolation Area, is separated from the area occupied by plains bison on the north side by two fences and a divided highway.

Habitat use by wood bison in spring, summer, and fall at Elk

Island was often recorded but not reported. A review of Warden wildlife cards by Blyth and Hudson (1987) indicated that many small areas of upland grassland were heavily used for feeding, whereas resting and travelling occurred mainly in the aspen forest. Roadside grasslands, grass-covered right-of-ways (boundary and cutline), and other small grassland sites are places where wood bison were consistently observed. In addition, a large number of sedge meadows were used for feeding year-round. The population appeared to be highly dispersed throughout spring and summer. However, during fall and winter, large herds often formed as a result of mixing of many small herds at Goose Lake meadows in the northeast area. At this time of year, the extensive area of wet meadow habitat around Goose Lake seemed to be preferred (Blyth and Hudson 1987).

Winter distribution of wood bison in EINP has been documented by Welch (1982). Feeding occurred mainly in wet sedge meadows and, to a lesser degree, along trails and in upland grasslands. Travelling most often took place in aspen forest habitat while resting primarily occurred around sloughs. A comparison of winter habitat affinities of bison at Elk Island, as described by Cairns (1976) and Welch (1982), indicated that wood bison use sedge meadows and wetlands more in winter than do plains bison. The use of wetlands could be related to availability because there are fewer areas of upland grasslands in the Wood Bison Area than there are in the main park (Blyth and Hudson 1987).

5.2 Habitat Assessment

The suitability of other potential ranges for wood bison has been assessed in the Liard-South Nahanni Rivers region, NWT (Reynolds et al.

1980), in the Nisling River valley, southwest Yukon (Reynolds et al. 1982b), and in the Hay-Zama Lakes area of northwestern Alberta (Reynolds et al. 1982d). Release sites have been selected in each of these areas and reintroduction projects are underway. Herbage standing crop yields decreased progressing northward from the Hay-Zama site with 3530 kg/ha, 2454 kg/ha at the Nahanni site in the southwestern NWT, to 1218 kg/ha at the Nisling River site in the southwestern Yukon; percent composition of sedges in meadow habitats varied from 41% to 97% (Reynolds 1986).

5.3 Food Habits

Many authors have recognized that bison are grazers primarily, eating a wide variety of grasses and sedges (Soper 1941; Peden 1976; Reynolds et al. 1978; Cairns and Telfer 1980; Reynolds et al. 1982a; Van Vuren and Bray 1983; Campbell and Hinkes 1983). The annual diet of bison in the Slave River lowlands near WBNP contained 29 different categories of plants (Reynolds et al. 1978). Slough sedge and reedgrasses were the most abundant dietary components, exceeding 70% of the diet in any season. Willow was identified in each season, but was a minor element of the overall diet.

In the MBS, wood bison consumed mainly sedges (more than 95%) during the winter (Larter and Gates 1987a). With the onset of renewed plant growth in May, diet composition varied greatly and included 47% shrubs (mostly willow leaves), 15% grasses, and 36% sedges. By mid July, shrubs were less than 20% of the diet whereas sedges had increased to become the dominant component (76%). The fall diet was composed of 45% grasses, 30% sedges, and 21% lichens. The high proportion of lichens in the diet is surprising and warrants further research into the

nutritional significance of this unexpected finding. High levels of browse (mainly leaves) have been reported in the summer diet of the plains bison herd near Farewell, Alaska (Waggoner and Hinkes 1986). The high proportion of shrubs in the spring diet of wood bison in the MBS appeared to reflect nutritional optimization rather than the lack of abundant early growth sedges and grasses.

From the initial results of the MBS study, it appears that wood bison exhibit more versatility in food habits than expected from previous reports on bison. The inclusion of shrubs, primarily willow, in the diet of wood bison greatly increases the carrying capacity of spring and summer ranges in the MBS.

5.4 Physiology

The physiology of wood bison has not been investigated, but it can be assumed to be similar to plains bison for which some information exists on digestion, cold physiology, and reproduction. Reynolds et al. (1982a) provided a comprehensive review of bison physiology. It would appear that bison are better adapted to northern habitats than are cattle because of superior digestion of poor quality forages and a greater cold tolerance.

The digestive efficiency of bison on low quality, fibrous forage is high compared with cattle (Peden et al. 1974; Richmond et al. 1977). This digestive superiority of bison should be adaptive under circumstances where forage is of poor quality and there is little opportunity for selection. Such conditions often prevail during winter when wood bison consume fibrous forages that are of low nutritional quality.

Bison are superior to cattle in their tolerance to cold.

Christopherson et al. (1979) observed that at -30°C, heat production in bison was less than that in cattle and the upper critical temperature for bison in winter appeared to be less than -10°C. The higher tolerance to cold by bison is, in part, attributed to well developed pelage insulation (Peters and Slen 1964).

5.4.1 Reproductive Physiology

Bison cows first conceive at between one and three years of age and usually bear a single calf. In two plains bison herds in South Dakota, few (6%) yearlings ovulated and none were pregnant; all two-year olds ovulated and 87% were pregnant (Haugen 1974). Among three-year old bison, 88% ovulated and 84% were pregnant. In WBNP, bison from two distinct areas exhibited different reproductive rates. At Hay Camp north of the Peace River, Fuller (1962) reported that 38% of two-year olds and 65% of three-year olds were pregnant. South of the Peace River near Lake Claire, pregnancy rates were higher where 59% of two-year olds and 81% of three-year olds were pregnant. Based on the occurrence of lactation in two-year olds, Fuller (1962) calculated that 4% of yearlings in the Hay Camp area conceived compared with 12% in the Lake Claire area. In WBNP, only 30% of wild bison over 15 years old were pregnant which suggested a decline in female fertility in bison between 12 and 15 years of age (Fuller 1962).

5.4.1.1 The Mackenzie Bison Sanctuary Population

In the MBS, 13 out of 19 (68%) mature wood bison females that were collected or captured during several winters were pregnant (C. Gates, pers. comm.). Age-specific reproductive rates were not determined. A calf:cow ratio (cows two years of age and older) of 61:100 was observed

in this population in November 1984. Calf production is higher in wood bison in the MBS than in hybrid bison in the Slave River lowlands and WBNP where it ranged between 21 and 31% of two year-old and older females from 1984 to 1986. Calf survival in the MBS between November 1984 and August 1985 was 62% (C. Gates, pers. comm.).

5.4.1.2 The Nahanni Population

The composition of the Nahanni wood bison population was determined in March 1985. There were 12 cows and six bulls that were two years of age or older in the population at that time. The sex of the yearlings was not determined. In June 1986, the composition of two subgroups was determined. One cow out of three in the Splits herd subgroup and six out of eight cows in the Liard herd subgroup were accompanied by calves resulting in a calf production rate of 64%. Calf production in the Nahanni herd was similar to that in the MBS population. However, calf survival in Nahanni appears to be low; only one to three calves survive to late winter. Poor calf survival coupled with accidental losses and poaching of adults are factors that presently limit growth of the Nahanni wood bison population. In spite of these limiting factors, the herd is increasing slowly at an exponential growth rate of 0.109 (C. Gates, pers. comm.).

5.4.1.3 Elk Island National Park Population

The structure of the wood bison herd at EINP has been described in terms of male:female ratios, calf:cow ratios, and age-sex structure (Blyth and Hudson 1987). However, caution should be exercised in interpreting the park data because of three major influencing factors: (1) the herd is fenced and may not be representative of a free-ranging

population, (2) the removal of a large number of adult females for disease control in 1969 caused significant changes in the male:female ratio, and (3) from 1976 to 1979 transfer removals for the recovery program were biased for females.

The initial herd of wood bison that survived at Elk Island in 1965 included four males and 17 females. During the first four years, the sex ratio of 24 males:100 females gradually increased to 73 males: 100 females. Slaughter of diseased females in 1969 reversed the ratio to 146 males:100 females in 1970. From 1970 to present, the proportion of females increased gradually, resulting in an almost even sex ratio from 1973 to 1977. By 1982, the sex ratio was 64 males:100 females.

An initially low calf:cow ratio of six calves:100 two-year and older females in 1966 rapidly increased to 82:100 by 1969. Following the removal of diseased adult females in 1969, there were only two calves produced in 1970. Records at that time indicated that both three-year old cows produced male calves. The calf:cow ratio (of cows two years old and older) declined during subsequent years in spite of the fact that the total number of calves produced increased. After 1972, the calf:cow ratio declined slowly to about 60 calves:100 two-year and older females. In 1982, a high ratio of 80 calves:100 two-year and older females was recorded for the herd. The average calf:cow ratio from 1965 to 1983 was 61 calves:100 two-year and older females and 83 calves:100 three-year and older females. From 1966 to 1987, twin calves were reported only twice, in 1974 and in 1985.

5.5 Diseases

Tuberculosis and brucellosis are two diseases prevalent in bison

in WBNP and vicinity (Choquette et al. 1961, 1978). Although the wood bison shipped to EINP in 1965 tested negative for these diseases, several cases of tuberculosis and one case of brucellosis were detected in the herd in 1968. An intensive disease eradication program was initiated in 1969. Diseases were eliminated from the EINP wood bison by 1971. All populations of wood bison in Canada are now believed to be free of tuberculosis and brucellosis.

Because wood bison selected for the transplant to the MBS were screened for diseases using techniques similar to those employed for the EINP transfer, it seemed possible that the Mackenzie wood bison could have been infected with tuberculosis and brucellosis. However, postmortem examination of 41 animals collected under scientific permit from 1982 to 1986 and tests for brucellosis on another 25 blood samples from captured wood bison have failed to detect either disease. Given the high prevalence of tuberculosis and brucellosis in infected bison populations, it would appear highly improbable that the wood bison in the MBS are infected. The high reproductive and low mortality rates observed in this herd tend to substantiate the apparent disease-free status.

5.6 Social Behavior

Social organization in plains bison has been described for herds in EINP (Shackleton 1968), Santa Catalina Island (Lott and Minta 1983), and Yellowstone National Park (McHugh 1958; Meagher 1973). The social behavior of hybrid bison in WBNP has been reported by Soper (1941) and Fuller (1960). However, the social behavior of wood bison has not been described. Wild populations of wood bison were nearly eradicated during

the late 19th century and those remaining were degraded by hybridization with plains bison prior to research being conducted.

A recent study of the behavior of wood bison in the MBS has revealed some aspects of the social organization in this population (Larter and Gates 1987b). Wood bison tended to associate in male-only herds or in herds of mixed composition dominated by cows and juveniles. The largest aggregations were seen during early summer, coinciding with the late calving and early post-calving period. Herding behavior during the calving season was not described. Herd size declined during the rut in August, September, and October, but increased during November.

Splintering of mixed herds into smaller groups corresponded with the onset of the rut in August. Radio-collared bison were located in forested areas during September and October, corresponding with the time that occupancy of open habitats decreased. The factors underlying this habitat shift and dispersal during the rut remain unknown. Nutritional factors related to plant phenology may be involved. Alternatively, the courtship or aggressive behavior of rutting bulls may influence group size and distribution. Dispersal during the rut in the MBS is contrary to the behavior of plains bison (McHugh 1958; Meagher 1973; Lott and Minta 1983), and European bison (Bison bonasus) (Krasinski 1978) which aggregate during the rut. However, the herding behavior recorded for wood bison during the rut corresponds with that reported for hybrid bison in WBNP (Fuller 1960) and in the Slave River lowlands (Calef and Van Camp 1987).

In the MBS population, bull groups dispersed during the rut in a manner similar to plains bison and European bison (McHugh 1958; Fuller

1960; Krasinski 1978). The prevalence of solitary bulls increased during this period. McHugh (1958) observed that solitary bulls circulated freely within and between mixed herds, leading him to believe that these bulls were probably breeders. Similar observations were recorded by Herrig and Haugen (1969) for a captive herd of plains bison at the Fort Niobrara National Wildlife Refuge in Nebraska. The role of solitary wood bison bulls during the breeding season in the MBS remains a question for further study.

6. MANAGEMENT AND RESEARCH

6.1 Research

6.1.1 Genetics and Taxonomy

Certain studies (Karsten 1975; Geist and Karsten 1977) have indicated that wood and plains bison exhibit distinct phenotypic differences. This has resulted in a general consensus that wood bison are distinguishable from plains bison on the basis of their larger body size, larger horn cores, darker pelage, lack of hair on their upper forelegs (chaps), and smaller beard. Employing multivariate morphometrics to analyze cranial, post cranial, and body size parameters, van Zyll de Jong (1986) considered that the phenotypic discontinuity in body characteristics fully justified the subspecific designation of wood bison. However, the conclusion of van Zyll de Jong (1986) is not readily compatible with the observations of Peden and Kraay (1979) who found that the blood types and carbonic anhydrase polymorphisms in wood and plains bison (as well as in wood-plains hybrids) were extremely similar. On this basis, they argued that the

present taxonomic status of wood and plains bison could be questioned. Other comparisons of wood and plains bison, involving blood typing (Zamora 1983) and karyotyping (Ying and Peden 1977), have not been able to distinguish relationships between the two bison subspecies. The data of recent studies (Upholt 1977; Lansmen et al. 1981) suggested that restriction endonuclease analysis of mitochondrial deoxyribonucleic acid (DNA) has the potential to clarify the genetic relationship and evolutionary history of wood and plains bison. However, preliminary work with mitochondrial DNA has also been inconclusive (Cronin 1986).

While the taxonomic status of wood bison may ultimately be confirmed on the basis of biochemical and genetic relationships, the significance of existing biochemical studies, such as that of Peden and Kraay (1979), is unclear. Because the biochemical parameters investigated in these studies had no obvious relationship to the characteristic phenotypic differences between the two bison subspecies, there is no reason why wood and plains bison would be expected to differ in these parameters. Therefore, it would be more appropriate to investigate genetic factors responsible for the phenotypic expressions peculiar to wood or plains bison.

Because size is an important character distinguishing wood and plains bison, a cooperative study, involving the Department of Animal Science, University of Alberta and the NWTWS, has been initiated to analyze genes known to regulate body growth. If the size difference between wood and plains bison is genetically determined, it must reflect functional differences in the alleles (forms) of growth-regulating genes present in the two subspecies. The objective of this research is to

characterize the alleles of five growth-regulating genes within populations of wood and plains bison. Employing recombinant DNA techniques, this characterization of genes will help clarify genetic relationships between (and within) populations of wood and plains bison. This research will also provide the foundation for interpreting evolutionary relationships among living and extinct forms of North American bison, as well as the European bison. In addition, this study will enable the estimation of relatedness of individuals within specific bison herds, thereby providing an effective technique for bison population management.

Through the cooperation of Parks, the CWS, and the NWTWS, DNA samples taken from EINP wood and plains bison, MBS wood bison, and Slave River lowlands hybrid bison are currently being analyzed to characterize growth-related genes.

6.1.2 Yukon Project

6.1.2.1 Management

The Yukon Department of Renewable Resources, YFWB has signed a cooperative agreement with Environment Canada, CWS to establish a free-roaming herd of wood bison in the southwestern Yukon. A range assessment has been conducted, a 6 km^2 enclosure has been constructed in the Nisling River valley, and 34 wood bison were transferred to the site in March 1986. A management plan, outlining the release schedule, will be completed for approval during 1987-88. The objective of the project is to establish a wild herd of up to 400 wood bison in the Nisling River watershed through participation in the national recovery program for wood bison.

6.1.2.2 Research

Wood bison did not occur in the Yukon in recent times; therefore, information in support of management of this subspecies has not been collected. Prior to development of the cooperative agreement in 1983, reconnaissance surveys were carried out to determine if suitable habitat existed and to assess potential release sites. An aerial survey of 26 different locations in the southern and central Yukon was conducted. A ground survey assessed vegetation types and herbage production. The Nisling River watershed was recommended as the best site for wood bison habitat (Reynolds et al. 1982c). The carrying capacity of the Nisling River valley was estimated at approximately 400 bison (Reynolds et al. 1982b). After the transfer of wood bison to the Nisling River site in 1986, other research requirements were identified and the following studies were initiated:

(1) Range Impact Assessment

The Habitat Section of the YFWB has established permanent vegetation transects in preferred habitat types inside and outside the enclosure. The objectives are to monitor and assess the impact of wood bison on the range and to refine carrying capacity estimates for the region.

(2) Range Mapping

A graduate student from Simon Fraser University conducted a study to determine the extent of potential range in the Nisling River valley for wood bison. The research included vegetation mapping, estimates of forage production of different vegetation types, and estimates of total carrying

capacity for the Nisling River valley (Mai 1987a, b). In addition, a cost/benefit analysis of the reintroduction project and recommendations for long-term management options are being prepared which will be useful for completion of the wood bison management plan.

(3) Resource Use Behavior

A graduate student from the University of Calgary is studying wood bison behavior in relation to range use and forage selection within the enclosure . A vegetation and range-use map of the 6 km^2 enclosure will be produced. In addition, the nutritional quality of several range forages will be assessed to determine their suitability for wood bison.

6.1.3 Manitoba Project

6.1.3.1 Management

Whereas management of the wood bison at Waterhen remains the ultimate responsibility of the Province of Manitoba, routine management is the responsibility of the Waterhen Indian Band through Waterhen Wood Bison Ranches Limited, a corporation controlled by the Band. Recently, the Manitoba wood bison introduction project has been reviewed in terms of its role in the economic development of the Waterhen Indian Band (Payne 1987).

Management of the captive herd is oriented toward calf production for release to the wild, with the intention of establishing a free-roaming herd. Supplemental feed in the form of hay is provided throughout the winter months. Minerals are also provided. The wild herd, if successfully established, will be managed in a manner similar

to other wildlife in Manitoba. In the future, the captive herd will be managed as a commercial wood bison ranch by Waterhen Wood Bison Ranches Limited.

6.1.3.2 Research

In 1984, a graduate student in the Department of Zoology, University of Manitoba conducted a habitat study at Waterhen on the potential of fire to enhance grazing conditions on fens. Although fire did not appear to increase productivity during the first year of growth, spring burning of fens was recommended to promote earlier growth and to enhance availability of forage by removing litter (Berezanski 1986). The negative impact of Tabanids (biting insects) on the feeding behavior of wood bison was also noted during this study.

The death of a wood bison precipitated research on bison-Tabanid relationships. During the summer of 1985, a graduate student at the Natural Resources Institute, University of Manitoba, conducted research on Tabanid populations at Waterhen. This study investigated the impact of Tabanids on the behavior of wood bison, the effect of spraying bison with permethrin, and management techniques to reduce negative impacts of biting insects on bison. Only one out of six Tabanid species present at Waterhen caused significant harassment to wood bison (Morgan 1987). In addition, the study demonstrated that permethrin is an effective chemical repellent against Tabanids, but a practical means of applying it to bison was not found. The Manitoba Fly Trap was effective for trapping Tabanids, but its effect on reducing local fly populations was not assessed. Morgan (1987) recommended continuing the search for effective repellents and a practical means of applying them as well as

continuing the use of fly traps.

6.1.4 Alberta Project

6.1.4.1 Management

During summer, the Alberta wood bison enclosure at Hay-Zama is monitored periodically by wildlife staff using fixed-wing aircraft or helicopters. During winter when ground access to the site is possible, inspection visits are carried out at least once a month to assess the physical condition of the bison. During late winter and spring, fecal samples are collected from the herd and submitted to Alberta Agriculture to determine parasite loads. A supplementary feeding program provided hay and a salt-mineral mix from December to April during the winters of 1985-86 and 1986-87. During the winter of 1986-87, a water tank and propane heater were installed to provide ice-free water to the herd. In March 1987, two earth pads (30 m x 30 m each) were constructed in the forested area of the enclosure to provide resting and calving areas for the bison during spring breakup. Supplemental feeding and watering of the herd is planned for the winter of 1987-88.

Release of the captive herd was scheduled for spring 1988, but the threat of infection with brucellosis and tuberculosis from hybrid bison migrating out of WBNP has caused reconsideration of the planned release. The release has been postponed until further evaluation of the problem is completed.

6.1.4.2 Research

Specific research is not being conducted at the Hay-Zama site nor is any proposed. The enclosure is isolated; therefore, periodic reconnaissance and minimal herd management are the only activities that

are presently being funded.

6.1.5 Northwest Territories Projects

6.1.5.1 Management

One of the goals of the NWTWS is to maintain a healthy and productive population of wood bison in the MBS (Government of the Northwest Territories 1987). In the absence of significant predation and disease, the MBS wood bison herd is expected to continue to increase and expand until forage resources or other factors begin to limit further growth. Hunting of wood bison will be permitted in the MBS commencing in late 1987 (Government of the Northwest Territories 1987). A limited number of male wood bison will be harvested by residents of the NWT, but only under the supervision of a Renewable Resources Officer. In future years, the quota may be increased as required to regulate the size of the population in relation to the desired stocking rate. Requirements for transplant stock will take priority over requests for increased quotas. Surveys to estimate calf production and total population size are carried out in July and March, respectively. With this information, it will be possible to objectively estimate an optimum size for the population relative to management goals.

The Nahanni-Liard wood bison herd remains vulnerable to catastrophic environmental and chance demographic events because of its small size. Although calf production appears to be good, calf survival is poor. The NWTWS has decided to enhance its management program for this herd by initiating a calf mortality study in addition to conducting annual population inventories.

6.1.5.2 Research in the Mackenzie Bison Sanctuary

The existing research program is examining social organization, patterns of resource use, plant-herbivore interactions in key habitats, and the health and condition of the MBS herd. Four major research studies are currently underway:

(1) Social Organization and Resource Use Behavior

Research was undertaken in 1986 in a cooperative project with the Department of Zoology, University of British Columbia. Seasonal patterns of resource use (food and space) and social organization of the population are being studied using direct observation and radio telemetry. Determination of seasonal habitat use patterns will be applicable to calculation of seasonal and annual carrying capacities for each habitat type.

(2) Plant-Herbivore Interactions

The influence of wood bison on plant growth in willow savanna and wet meadow habitat types is being examined by the Department of Botany, University of Alberta. Wood bison have a noticeable impact on the structure of mesic meadow habitat (willow savanna) in the MBS as a result of foraging activity during the early growing season. The impact that winter grazing will have on plant growth in wet meadows during the next growing season is also being studied.

(3) Animal Health and Condition

Under scientific permit, five cows and five calves are collected from the MBS twice each year to assess seasonal changes in health and condition. The first collection occurs during late fall or

early winter to determine peak body condition and the amount of growth of calves. The second collection occurs during late winter and is used to assess change in condition of the bison over winter. This research is being conducted by the Department of Animal Science, University of Alberta, in cooperation with the NWTWS.

The Animal Pathology Laboratory, Agriculture Canada, Saskatoon participates in the field work with postmortem examinations of collected bison and conducts any pathology, bacteriology, and histology examinations that may be required. Also, the Veterinary Services Division, Alberta Agriculture, Edmonton is cooperating by examining bison that have been collected for parasites.

(4) Habitat Evaluation

During 1983-86, a primary range survey provided a description of physiography and vegetation of the MBS (Mychasiw 1987). A map of major vegetation types was developed using digital analyses of multispectral Landsat II data. Areas were selected in each cover type where ground sampling provided botanical description data for use in classification analyses. A computer generated map was produced by combining physionomically similar community types into nine cover types. The area of each cover type identified on the map was calculated. Plant sampling late in the growing season was used to estimate total herbage available in each cover type. Using mapping techniques in combination with herbage production data and information on seasonal habitat use and diet selection, it will be possible to calculate a conservative estimate of

carrying capacity of the primary bison range.

6.1.5.3 Research in the Nahanni-Liard Region

During February 1987, three adult female wood bison in the Nahanni-Liard population were radio-collared to assist with tracking and relocating the different subgroups to study calf mortality. The season and, if possible, the causes of mortality will be examined. Unfortunately, one collared female had to be destroyed in the spring of 1987 after it had been severely mauled by wolves. A transfer of 10 to 20 wood bison from the MBS to increase the viability of the Nahanni-Liard population is being considered.

6.1.5.4 Evaluation of New Introduction Sites

The long term plan is to evaluate one new site each year during the next several years. In 1986, a prospective site located in the vicinity of Bulmer Lake near the Mackenzie River north of Fort Simpson was evaluated as a potential release area for wood bison. Although the site contained productive sedge communities, it was assessed as being too wet to provide spring or summer range for bison.

6.2 Research Requirements

6.2.1 Genetics and Taxonomy

Further research would be useful to confirm the presently accepted taxonomic status of the wood bison. The development of recombinant DNA technology offers a novel approach for taxonomic investigations. This technology can be used to study genes likely to determine phenotypic differences between wood and plains bison. A study of growth-related genes in bison has been initiated by the University of Alberta. Because the process of genetic regulation of mammalian hair color has been

described (Prota and Thompson 1976), a similar study of "hair color" genes would be useful in understanding genetic relationships between the two subspecies of bison.

Reynolds et al. (1982a) indicated that additional information on the evolutionary history of bison would help clarify taxonomy. Recombinant DNA techniques could provide a mechanism for explaining the evolutionary relationships among living and extinct forms of bison. Tissue samples of extinct forms of bison from northern Canada have been recovered in a frozen state. Under such conditions, DNA remains stable; therefore, the structure of specific genes from extinct forms can be compared with genes of living North American and European bison via restriction endonuclease analyses and gene sequencing.

Other molecular techniques that would be useful in taxonomic and phylogenetic studies of bison include heterologous somatic cell hybrids and in situ hybridization of cloned DNA fragments to metaphase chromosomes These techniques have been valuable in revealing phylogenetic relationships among many species of mammals (O'Brien 1986).

The current taxonomic status of bison in WBNP has not been fully assessed because too few specimens from herds occupying different areas of the park were available (van Zyll de Jong 1986). The movement and exchange of individuals among different local populations after the introduction of the plains bison probably caused a varied degree of hybridization among herds. Taxonomic assessment of herds from the northern part of the park and adjacent lands is required to determine if they might represent stock that is close to the original wood bison. A morphometric analysis of these herds would be useful to assess the

degree of hybridization and to interpret the impact of the introduction of plains bison on the phenotypic variation of bison populations inside and outside WBNP (van Zyll de Jong 1986).

6.2.2 Population Dynamics

Basic data concerning age-specific production rates, survival rates, and sex ratios are essential as part of the information base required for proper management of wood bison. Statistical definition of each of these variables would be desirable for six different age categories: conception, parturition, neonatal, post neonatal, juvenile, and adult. Values for each herd of wood bison should be obtained annually because environmental conditions affecting the parameters vary among different geographical locations.

6.2.3 Habitat and Nutritional Requirements

Food habits and consumption rates are directly related to the energy and nutrient requirements of the animal. Survival depends on the ability of the animal to balance these needs with the forage available in different seasons. Food habits can be investigated by examining habitat use patterns, forage availability, and nutrient requirements. Throughout the range of wood bison, snow cover parameters such as depth, density, and hardness, and the duration of snow cover can affect forage quality as well as access to the food. Snow parameters should be assessed and food habits determined for each of the herds of wood bison.

Forage quality and quantity may be enhanced by using various range improvement techniques such as cultivation, application of fertilizer, mechanical clearing, and manipulation of drainage. Some of these options should be explored to improve range for wood bison in Manitoba,

Alberta, and British Columbia. A variety of habitat features such as availability of minerals, cover habitat, and water can affect the value of an area to wood bison. There is a need to assess habitat characteristics in each of the wood bison areas.

Other sites within the historic range of wood bison should be evaluated to determine the potential for additional releases in the future. Ranges currently being grazed by bison and those to be grazed by free-roaming wood bison should be assessed to determine carrying capacity. The need to research habitat and forage requirements of wood bison is considered a high priority.

6.2.4 Predation

Several large predator species are capable of killing bison. Wolves (Canis lupus), grizzly bears (Ursus arctos), and black bears (U. americanus) have been observed preying on bison, but of these three, the wolf appears to be the most threatening. In assessing the role of predation there is a need to identify predator-prey ratios, to determine age-specific prey losses to predators, and to determine the role of alternate prey. Predator-prey investigations should be conducted in free-ranging wood bison populations.

6.2.5 Adaptive Behavior

Some behavioral traits of wood bison are critical to its survival and are important to management. Four strategies of wood bison behavior requiring additional study are foraging, anti-predator, dispersal, and reproductive. The mating systems of plains and wood bison appear to differ somewhat; therefore, the structure and behavior of small rutting groups and the association of solitary males with them needs to be

described for wood bison.

Behavioral studies are more easily conducted on captive herds; however, determination of anti-predator and dispersal mechanisms will require reference to free-ranging herds. The timing and degree of dispersal from a release site is especially significant for introduced herds and should be monitored in all projects where releases of wood bison occur.

6.2.6 Animal Health

Several diseases and parasites (internal, external, and free-living) that can infect bison have been identified. Monitoring of herd health and determining options to alleviate potential problems are research activities that should be conducted in areas inhabited by wood bison.

6.2.7 Competition with Other Species

It is unlikely that other ungulates would be able to displace wood bison from suitable habitat once wood bison become established in an area. Another important consideration is whether other species might be displaced by bison. In northern Alberta, the potential exists for wood bison to displace woodland caribou (Rangifer tarandus caribou) or white-tailed deer (Odocoileus virginianus), the latter species being at the northern edge of its continental range. The high percentage of lichens in the fall diet of wood bison in the MBS (Larter and Gates 1987a) suggests that bison diets might overlap with those of woodland caribou in some situations. There is potential for dietary competition with woodland caribou in northern Alberta and in the Yukon. Competition for range could develop in the Yukon with existing populations of Dall

sheep (Ovis dalli) and elk depending on the direction of movement of released wood bison. Moose (Alces alces) and bison generally do not compete for food because of different preferences in the areas where present ranges overlap. Also, moose tend to be solitary and occur at relatively low densities throughout currently used wood bison ranges. However, the level of understanding of inter-specific competition and other interactions is presently insufficient.

6.2.8 Reproductive Problems in Captive Herds

There is a need to investigate why the Waterhen and Hay-Zama captive herds have experienced reproductive failures. Factors such as biting flies, forage availability, nutritional quality of forage, the effect of stress of introducing stock born and raised in zoos to the more extreme environmental conditions of natural habitats, the stress of relocation, and the length of time required for adaptation of reintroduced animals to different environments should be examined as potential causes of reproductive problems. An evaluation of intrinsic and extrinsic factors that might affect each of the herds that are experiencing reproductive problems is required.

7. LIMITING FACTORS

Environmental, biological, or chance events will influence the growth or decline of wood bison populations in Canada. However, few of these factors are thoroughly understood. Some limiting factors can be manipulated to provide transplanted wood bison with the best opportunity possible for survival. One can speculate about the future of wood bison; however, detailed research is required to assess specific factors

that influence mortality and reproduction in free-ranging herds.

7.1 Diseases

Anthrax was first diagnosed in bison in the Slave River lowlands in 1962. Outbreaks caused losses of 1098 bison in the Slave River lowlands and WBNP during a 16-year period (Broughton 1987). Infection with anthrax, a bacterium, is characterized by its sudden onset and rapid fatal course and, in herbivores, is caused by soil borne contamination from infected carcasses. When an outbreak occurs, transmission can be achieved by biting insects; however, bison are not normally carriers of this disease. Infection with anthrax has not been reported in the Slave River lowlands or WBNP since 1978 and, therefore, does not appear to be a major factor in population dynamics of bison at the present time. However, because the area is contaminated with anthrax spores the threat of an outbreak remains a hazard to free-roaming bison (Coupland 1975).

Broughton (1987) reported that bison in WBNP and the Slave River lowlands have a high incidence of tuberculosis and brucellosis, diseases which have probably limited survival and productivity in these herds. Diseases may predispose bison to predation by wolves in addition to causing direct losses. Tuberculosis probably causes at least a 15% reduction in productive capacity in terms of feed efficiency, weight gain, and milk production (Blood et al. 1983). Brucellosis may contribute to the difference between expected and observed calf crops in WBNP, Slave River lowlands, and the MBS. In WBNP between 1950 and the mid 1970s, the bison population declined from 12,000 to 4500. The effects of brucellosis and tuberculosis, with infection rates of about

36% in the bison, may have contributed to that decline (R. Coupland, pers. comm.). The combined effect of tuberculosis and brucellosis on bison in the Slave River lowlands and WBNP is not known but the prevalence would suggest that growth of bison herds may be limited by these diseases.

Transmission of brucellosis and tuberculosis requires direct contact with an infected animal or with contaminated feed or water. Live organisms usually persist for only a short period outside the host. Contact with aborted fetuses is an effective means of brucellosis transmission. Insect borne transmission of either disease has not been demonstrated in studies with infected domestic stock. Transmission by other wildlife species acting as vectors may be possible (Tessaro 1986).

None of these diseases has been reported in MBS wood bison. Wood bison transferred to Nahanni, northern Alberta, Manitoba, and the Yukon were tested for tuberculosis and brucellosis prior to shipment and were certified disease-free by Agriculture Canada.

7.2 Predation

Wolves kill more bison than any other predator. The difference between predation and scavenging is often difficult to determine; therefore, the actual impact of wolves as a direct cause of mortality cannot always be demonstrated. Wolves may have an indirect effect on bison by influencing habitat selection. Harassment by wolves may lead bison to select habitat that is less than optimal regarding forage availability and prevalence of biting insects (Carbyn and Trottier 1987). Observed predation by wolves on bison in the Slave River lowlands indicated that a significant portion of annual mortality was

caused by wolves and confirmed that bison calves are the most vulnerable cohort (Van Camp 1987). However, two years of intensive wolf control did not reverse the established decline in that bison population.

Most research into wolf predation has dealt with prey species other than bison. The predator avoidance strategy of bison is likely different from other prey species because of the large weight differences between bison and wolves. Therefore, caution should be exercised when extrapolating results from wolf predation studies on prey species other than wood bison. Based on observations in the Slave River lowlands and WBNP, mortality caused by wolves could be expected when wood bison are introduced into areas already occupied by wolves. On the other hand, the high growth rate in the MBS wood bison population occurred in the presence of a healthy wolf population (C. Gates, pers. comm.). This would suggest that wolf predation may not be a serious management problem for reintroduced wood bison.

Wolves and black bears are present in all locations where wood bison have been introduced. It is possible that black bears could prey on new-born bison calves. In Manitoba one new-born calf was believed to have been killed by a black bear (H. Payne, pers. comm.). At the Nisling River site in the Yukon, predators occur at low densities probably because prey is scarce in that area (M. Hoefs, pers. comm.).

7.3 Poaching and Accidental Deaths

In areas of introductions, wood bison are protected from hunting by legislation or by cooperative agreements with native people. In the future, hunting will be permitted and managed so that population growth will not be adversely affected. Illegal killing of bison (poaching)

occurs in the MBS, where, on the average, two animals are lost per year (C. Gates, pers. comm.). In WBNP, illegal hunting of bison occurs occasionally (R. Redhead, pers. comm.). Poaching of wood bison at reintroduction sites is not expected to be a problem that will adversely affect herd growth, mainly because of the high public profile of wood bison.

Accidental deaths are rarely a major mortality factor in established bison populations. In most situations, accidents are chance occurrences that could adversely affect small populations. However, accidents, particularly drowning, could be significant to a small reintroduced herd of wood bison. Spring floods or thin ice are the most hazardous situations for wild bison (Reynolds et al. 1982a). In WBNP, periodic losses of large numbers of bison from drowning have been recorded, for example, spring flooding in 1961 and 1974 caused the loss of several thousand bison (Mitchell 1976). Under such atypical circumstances, drowning can cause significant mortality in bison populations.

7.4 Agricultural Expansion and Other Industry

Most areas selected for establishment of wild populations of wood bison have little if any agricultural land-use. Within the historic range of bison, agricultural development represents a permanent loss of habitat because free-roaming bison are not compatible with cultivated crops or grazing land. Two commercial cattle operations were developed adjacent to the MBS in the late 1970s. However, both operations have failed to become viable but land leases have been perpetuated. Significant development has occurred in the Fort Vermilion and Keg River

regions of northern Alberta where future dispersal of reintroduced wood bison might conflict with private agricultural land. Additional expansion of agriculture has been proposed for the Jean D'Or Prairie area east of Fort Vermilion. Agricultural development is not a concern in the Yukon. In Manitoba, the potential for conflict between free-roaming wood bison and agricultural interests exists. The southern boundary of the expected range of wood bison is adjacent to established cattle range, approximately 30 km from the Waterhen enclosure, and is adjacent to native hay land on the west along Waterhen Lake.

Other activities such as petroleum exploration and development, logging, and trapping would have little impact on wood bison habitat. Free-roaming wood bison may come into conflict with settlement areas in Alberta and Manitoba. Developed highways and road allowances may attract released wood bison and have an influence on dispersal patterns. Bison on roadways would be a hazard. In addition, roads provide easier access for poachers.

7.5 Environmental Factors

Harrassment by biting insects can be a problem in captive situations where animal movement and escape from these pests is limited by a fence. Insect harrassment is thought to have had a detrimental effect on reproduction and may have caused mortality in the Waterhen herd (Payne 1987). Severe insect harassment could detrimentally affect growth and fat deposition in wood bison in northern Canada.

Forage quantity, quality, and availability could affect productivity of wood bison. The quality of forage in winter may be limiting to the Hay-Zama, Yukon, and Manitoba herds. Bison are tolerant

of cold temperatures (Christopherson et al. 1976), but extended periods of deep snow can impede movement and cause foraging difficulties. Hard snow can restrict foraging activities not only for the young but for the adults as well (Reynolds and Peden 1987).

7.6 Geographic Limits to Recovery of Wood Bison

The historic range of the wood bison lies largely within the Mackenzie Basin, including the Peace, Athabasca, Slave, Hay, and Liard River drainages (Fig. 1). The Yukon introduction site is outside the historic range but falls within the prehistoric range of the wood bison. Although the Waterhen site is outside the former range of the wood bison, it was judged as providing suitable habitat for wood bison.

Further recovery of wood bison within historic range is limited by the occurrence of captive or free-ranging herds of plains bison and hybrid bison within the range. The genetic distinctiveness of wood bison would be compromised by hybridization with other subspecies or strains if mixing were to occur because of escapes from ranches or sympatry with other free-ranging herds of hybrid or plains bison.

The approximate straight-line distances between free-ranging plains or hybrid bison herds and existing herds of wood bison are summarized in Table 2. In 1985, approximately 350 plains bison were free-ranging near Pink Mountain in northeastern British Columbia. This herd was brought into the province under permit by a private land owner in the early 1970s, but it soon escaped captivity to become a wild population. A free-roaming herd of about 45 plains bison occurs along the southwestern border of Prince Albert National Park, Saskatchewan; however, this is within the historic range of plains bison. Another

Table 2. Potential sources of genetic contamination to free-roaming herds of wood bison from other wild herds of plains and/or hybrid bison.

Region Wood Bison herd	Herd size	Minimum distance between herds (km)	Other herds	Herd size	Herd type	Reference number on Fig. 5
1. Core historic range:						
(a) Mackenzie Basin:						
(i) Mackenzie Bison Sanctuary (free-roaming)	1600+	125*	Wood Buffalo National Park	4200	Hybrids	12
		150*	Slave River lowlands	200	Hybrids	13
		550	Pink Mountain	350	Plains bison	10
(ii) Nahanni-Liard herd (free-roaming)	30	325	Pink Mountain	350	Plains bison	10
		425	Wood Buffalo National Park	4200	Hybrids	12
		560	Slave River lowlands	200	Hybrids	13
(b) Northwestern Alberta						
(i) Hay-Zama Lakes (captive for release to wild)	43	200	Wabasca	150	Hybrids	11
		225	Wood Buffalo National Park	4200	Hybrids	12
		300	Pink Mountain	350	Plains bison	10
		375	Slave River lowlands	200	Hybrids	13
		450	Firebag River	20	Hybrids	15
2. Other ranges:						
(a) Manitoba:						
(i) Waterhen (Northern Interlake) (captive for release to wild and for commercial production)	106	525	Prince Albert	45	Plains bison	7
		750	Primrose	35	Plains bison	9
(b) Yukon						
(i) Nisling River (S.W. Yukon) (captive for release to wild)	45	500	Delta Junction, Alaska	300	Plains bison	14
		850	Pink Mountain	350	Plains bison	10

* across Great Slave Lake.

herd of approximately 35 bison (assumed to be plains bison) is free-roaming near Primrose Lake on the Alberta-Saskatchewan border. In addition, four herds of hybrid bison are found within the historic range of wood bison: 1) Slave River lowlands, NWT (200); 2) WBNP (4200); 3) Wabasca River (150) as described by Gainer (1985) and found southwest of WBNP; and 4) Firebag River (20) located southeast of WBNP. Hybrid bison move freely across the west boundary of WBNP in their travels along the Peace River corridor.

In western Canada, there are at least 113 captive herds of plains or hybrid bison, 11 of which are located within the historic range of wood bison (Fig. 5). These herds are privately owned. Commercial propagation of bison is a relatively new, rapidly expanding industry which is supported in policy by the governments of Saskatchewan, Alberta, and British Columbia. In Manitoba, bison farming is permitted but is not given special consideration by government. Captive herds of plains bison pose a threat to adjacent free-ranging wood bison only if they escape confinement and roam free or are otherwise able to interbreed with wood bison.

Given the current low numbers of wood bison and the limited geographic area within their historic range that is occupied, hybridization between plains or hybrid bison and wood bison in this area is undesirable at the present time. Therefore, the existence of plains or hybrid bison in areas where wood bison reintroductions are possible imposes a constraint on the recovery of the wood bison within its historic range.

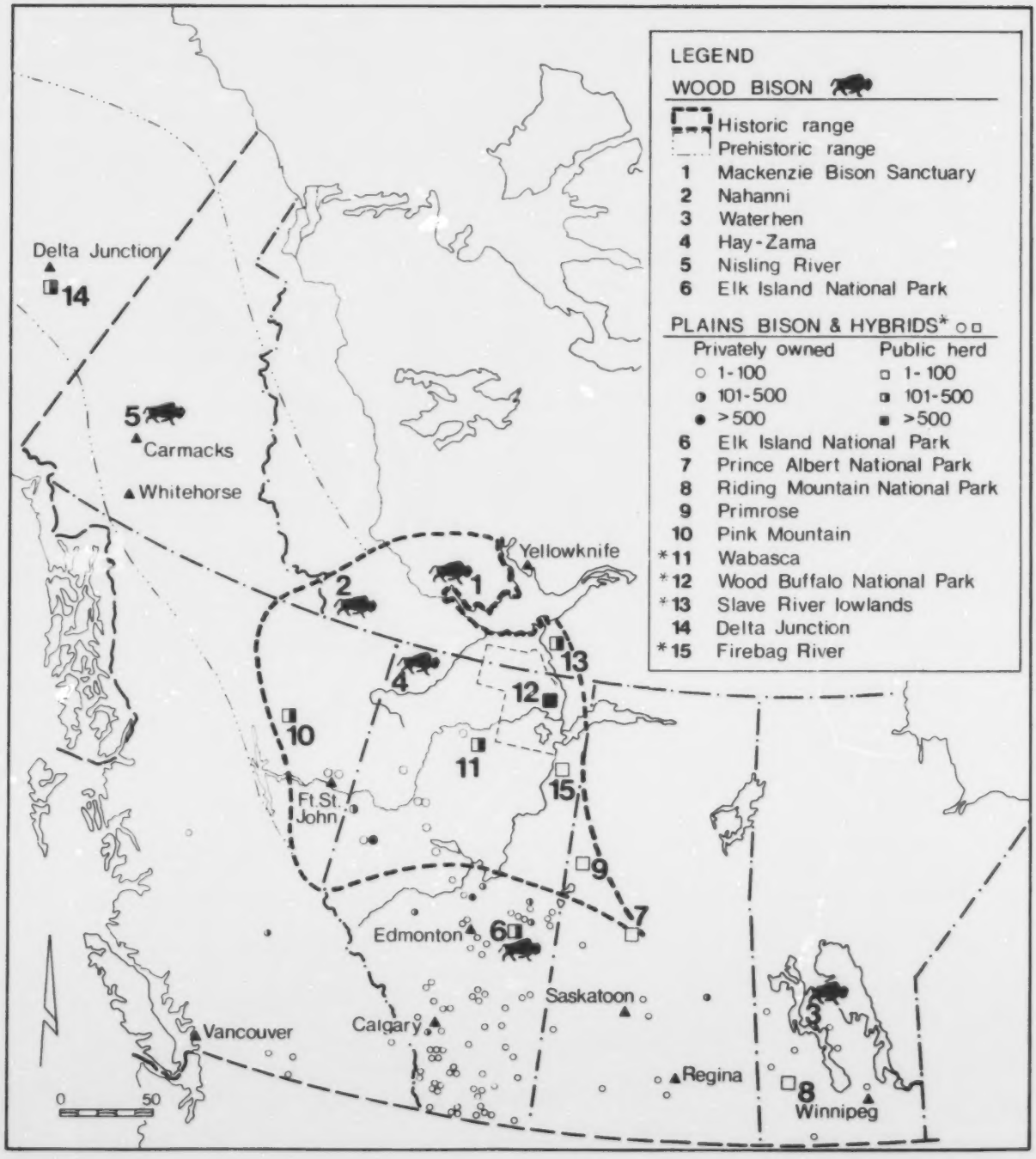

Figure 5. Distribution of captive and free-roaming herds of Bison in western Canada in 1985.

8. RECOMMENDATIONS ON THE STATUS OF WOOD BISON

COSEWIC STATUS (October 1978) = ENDANGERED

RECOMMENDED CHANGE (December 1987) = FROM ENDANGERED TO THREATENED

The Wood Bison Recovery Team (WBRT), in recommending the numbers of animals required to meet criteria for downlisting and eventual delisting of wood bison, has identified two basic objectives: (1) to provide sufficient numbers of wood bison above the absolute mathematical minimum required to ensure herd viability to prevent extinction (20-25 individuals) and (2) to provide sufficient numbers of wood bison to secure conservation of the subspecies. The WBRT agrees that the management goal of a minimum of 200 animals per herd is a conservative size required to ensure viability of that population. For the purpose of downlisting and delisting wood bison, only populations owned or controlled by government will be considered. The WBRT suggests that fenced populations of wood bison of sufficient size, in addition to free-ranging populations, be accepted to meet the recommended criteria for delisting and downlisting. Wood bison are now widely distributed throughout their historical range. Numbers of wood bison have increased at least five-fold since 1978 when they were designated an endangered subspecies (Novakowski 1978), to in excess of 2300 in 1987. Accordingly, the WBRT recommends immediate downlisting of the wood bison from ENDANGERED to THREATENED.

8.1 Specific Downlisting Criteria:

RECOMMENDED CRITERIA	JUSTIFICATION FOR STATUS CHANGE
(1) There must be at least three geographically separated and stable or	At present, two geographically separate herds, the wild free-roaming population in the MBS of greater than 1700 animals and

increasing populations of wood bison.	the EINP herd of approximately 250 animals, are showing significant annual increases with production of calves. The Waterhen herd of 106 animals is slowly increasing. A free-roaming herd of 30 animals exists in the Nahanni-Liard valley; however, this herd is increasing slowly because of continuing problems with survival of calves. In addition, the Hay-Zama herd of 43 wood bison in northwestern Alberta and the Yukon herd of 45 animals are two fenced populations to be released to the wild. In 1980, seven wood bison emigrated from a transplant to the Nahanni region, NWT into British Columbia; however, their current status and distribution are unknown. In addition, seven captive breeding herds totalling 144 wood bison have been established in zoos and wild animal parks.
(2) The conservation of each population must be assured through formal legislation or by cooperative management.	Wood bison are listed in the Northwest Territories Act as endangered species, where protection is provided through cooperation, reinforced by legislation. In the MBS, harvesting will be permitted according to sound principles of wildlife conservation as outlined in the management plan (Government of the Northwest Territories 1987). Conservation of the Waterhen herd is presently afforded through designation of the enclosure as a Wildlife Refuge where hunting and trapping are not permitted. When released to the wild, wood bison will be defined as wildlife in the Manitoba Wildlife Act and will be classified as endangered. In Alberta, wood bison are listed in the Wildlife Act as an endangered species and are thereby protected. In the Yukon, wood bison are listed as a specially protected species in the Wildlife Act and are protected from hunting. The YFWB is developing a policy that will prohibit importation of plains bison. EINP is a sanctuary under the National Parks Act and thereby affords full protection to the wood bison herd.

(3) There must not be any forseeable threat to wood bison habitat at any of the five introduction sites.	In the MBS there is no current nor foreseeable land-use conflict. The NWT Government is commencing discussions with the Federal Government with respect to limiting agriculture and other large scale developments. In Manitoba, the enclosed lands are fully protected from other land-uses under the Wildlife Refuge status. Plans are to designate the proposed release site a wood bison management area that will have special protective status against other land-use development. In Alberta, the area of the wood bison enclosure has been protected from other land-uses through a land reservation. An extensive area in northwestern Alberta has been identified as a wood bison management zone. In the Yukon, the area of the enclosure has been protected through placement of a land reservation. The YFWB has proposed that the release area be designated a Wood Bison Range in which land-use can be controlled. In EINP, habitat protection is ensured through legislation under the National Parks Act.
(4) Populations of wood bison must be available to provide stock for reintroductions.	EINP and the MBS currently have surplus stock available for additional reintroductions or for genetic exchange among isolated populations and captive breeding herds.

8.2 Specific Delisting Criterion:

DELISTING CRITERION	JUSTIFICATION FOR DELISTING CRITERION
There must be at least four geographically separate populations in existence with a minimum of 200 bison in each, or four populations of at least equal biological viability. The sex ratio should be adequate to ensure genetic integrity and reproductive performance.	Although it is impossible to accurately define a minimum viable population size, it is the deliberated opinion of the WBRT that a population of 200 wood bison sufficiently exceeds a minimum number to ensure the long term survival of a population. Examples of viable small populations suggest that this number (200) is unquestionably conservative. The Mackenzie and Nahanni-Liard populations grew from 18 and 14 animals, respectively, in the presence of predators and other natural limiting factors.

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APPENDIX 1. The Wood Bison: An Indian Perspective

By: Harvey Nepinak, Chief of the Waterhen Indian Band

Like the wildebeest in Africa, the buffalo shaped the landscape of North America. For the first North Americans, the buffalo provided all basic needs. Other animals were used for many purposes, but the buffalo was the essential staple of life on the continent. During the Indian wars, the significance of the buffalo was well recognized when General Sheridan suggested to the Texas Senate and House that a medal be struck for buffalo hunters, depicting a buffalo on one side and a disillusioned Indian on the other, because in his view the buffalo hunters were doing more to destroy the Indian than the entire United States army.

For the Indian and the buffalo alike, the 1880s were troubled times. Fate, fortune, or perhaps a few chance happenings, saved both the Indian and the buffalo from extermination. There is a story about how an Indian saved the buffalo during the hard times following the Indian wars.

Samuel Walking Coyote was a Pen d'Oreille Indian who lived with the Flathead Indians on their reservation in what is today western Montana. In 1872, Walking Coyote moved east across the Rockies to a Blackfeet reservation where he spent the winter of 1872-1873 hunting buffalo with the Blackfeet. When spring came, Walking Coyote became homesick and decided to return to the Flathead reservation. Several days later he was still pondering the plan when eight buffalo calves wandered into his camp; some had been orphaned during the hunt whereas others had become separated in the chase. Apparently the little buffalo soon attached themselves to the Indians' horses and Walking Coyote got

the idea to set out across the Rockies with the eight buffalo. However, there were problems with the plan. Flathead law prohibited taking a wife from anywhere but on the reservation and the Jesuit Fathers of the Flathead Mission did not approve of any man taking more than one wife.

It was a rough journey across the Rockies, two of the calves died, but six survived the trip. In the spring of 1873, Walking Coyote and six buffalo calves arrived at the Jesuit Mission. Walking Coyote set up home in the Flathead Valley where he raised his buffalo calves on its good grass. According to how the story goes the buffalo did extremely well in the Valley. They became exceptionally tame and the heifers produced calves when they were four years old. By 1884, Walking Coyote's buffalo herd numbered 13 and they were becoming a problem. They were taxing Walking Coyote's meager resources and annoying his neighbors.

Reluctantly, because he loved the buffalo, Walking Coyote put them up for sale. The herd was sold to Charles Allard and Michel Pablo. Walking Coyote insisted on cash and was paid $2000 in gold. The buffalo was now well on the road to recovery largely due to the economic rather than the conservation interests of Allard and Pablo.

Most of the buffalo that grew from Samuel Walking Coyote's herd were sold to Canada where buffalo still lived in the northern woods. Those buffalo were different. They were bigger, with a higher hump and never ventured out on the plains. The northern Indian knew them well and scientists called them the wood bison. Strangely, when the bison were massacred on the plains, the wood bison greatly decreased in number, almost in sympathy with their plains cousins. The biologists cannot explain what happened, but by about 1880 the wood bison was

almost extinct. Fortunately, the Dominion of Canada afforded protection to the wood bison and the population recovered.

When all seemed well with the northern buffalo, trouble started with the plains bison at Wainwright, Alberta. They didn't have enough range. So, they moved them north, where they did not belong. They brought disease and crossbred and virtually destroyed the remaining wood bison.

But, the northern bison survived once more and were rediscovered almost 40 years later. Their rediscovery led to a major government program to restore the wood bison.

For more than 20 years, Indian people like Samuel Walking Coyote have helped the program and the buffalo. In the Mackenzie Bison Sanctuary, the Indian people have not hunted the buffalo. Recently, there have been two new projects, one in Alberta near Hay-Zama and one in Manitoba near Waterhen. The local Indian people have agreed not to hunt and the projects are well on the way to success.

I do not expect that the Indian people will ever again enjoy the freedom and buffalo hunts of the past. Those days are gone. But at least for the people of the Waterhen Band and perhaps others, the return of the buffalo offers a new way of life. In a new era, in a new context, in a different way, the buffalo and the Indian are once more living together in harmony.

I cannot speak for all Indian people, but I am pleased to be part of the effort to bring back the wood bison. I do not want to live in the past. But, I want to know the past because it helps me to live in the present and to plan the future.

I sometimes wonder where the buffalo will lead me. I control his movement today with a fence, but I plan to release him. The things that have happened on the land over the last hundred years could be damaged by the buffalo. If this is the case, the buffalo cannot be free. In some parts of Canada, the buffalo or wood bison may have to be restricted to an enclosure or a reserve.

The buffalo in the past was a big part of the Indian way of life. It can be so again, but it must be in a new way. I am searching for the way to make it so and I am sure I will find it. The buffalo and the Indian are a union that cannot be broken. Together we can both live and that is why I support the wood bison recovery program.

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